

# NEW MATRICULATION ZOOLOGY



7

# To the teacher

New Matriculation Zoology is a series of five books developed for class 6-10 of the Tamil Nadu Matriculation system. It closely follows the new enriched Matriculation syllabus.

One of the main features of the new syllabus is that activity and observation are given a very important place in understanding science. Every effort has been made to unfold the scope and purpose of the syllabus. This series departs from the conventional and emphasises a practical, 'discovery' and 'learning by doing' approach.

The subject matter to be studied has been carefully arranged keeping in mind the age level and psychology of the child. No effort has been spared to support the text with clear, labelled illustrations. The language has been kept simple and direct to enable the students to read the text themselves.

Several activities and projects have been suggested, wherever possible, within the scope of the lesson. Most of these need simple improvising or inexpensive materials.

The exercises for each chapter are exhaustive and include questions based on comprehension and application of basic principles rather than on mere recall.

It has been the concern of the authors that children are encouraged to discover for themselves the pleasure of learning about the fascinating world of 'animals'.

The author

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New Matriculation Zoology 7

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# NEW MATRICULATION ZOOLOGY

# 7

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# MATRICULATION SYLLABUS FOR STANDARD VII - ZOOLOGY

S.No.	Concept/Theme	Expected learning outcome	Teaching/Learning Activities
1.0.	DIVERSITY OF LIVING ORGANISMS		
1.1.	Living world with reference to size and shape. Microscopic and macroscopic habits and habitats.	Discriminates between living and non-living things. Analyses the concept of unity in diversity with ref. to life on this earth.	Examination of pond water, observation of living specimens in nature, collection and observation of preserved specimens such as yeast, paramecium, hydra, earthworm, insect, spider, fish, frog, lizard etc.
1.2.	Common features of all living things.	Recognises different levels of life from unicellular forms onwards.	Listing of unicellular and multicellular animals. Observation in natural surroundings. Listing out the points of differences.
1.3.	Levels of organisation.		
1.4.	Classification of organisms.	Recognises the simple and complex forms of animals existing in nature.	By giving a collection of worms, insects, fish, frog, reptiles, birds and small mammals, the student is asked to classify them into animals with and without backbone.
1.5.	Need for classification, utility of classification.		
1.6.	Basis of classification.		
1.7.	Major groups of animals.		
1.8.	Animals without backbone (worms and insects) invertebrates.		
1.9.	Animals with backbone (fishes, frogs, reptiles, birds and mammals) vertebrates.		
1.10.	Microorganisms protozoans - Plasmodium, Entamoeba.	Recognises that micro organisms other than bacteria occur in the world. Recalls the diseases caused by them. Recalls various ways by which diseases are spread.	Observes under microscope some other microorganisms like Protozoans, and learns the diseases caused by them and finds out preventive measures. Makes a list of antibiotics and the diseases for which they are used by visiting a public health centre or any other source in pupils locality. Makes a list of carriers and diseases spread by them. Collection of pictures of vectors of common diseases.
1.11.	Spreading of Microbes.		Collects posters prepared by health department with reference to diseases caused by different types of mosquitoes.
1.12.	Direct contact, air, water insect.		Finds out the various ways of preserving food in order to prevent spoilage by microbes.
1.13.	Carriers (vectors).	Recognises the disease carriers. Analyses the role of vectors.	
1.14.	Life cycle of malarial parasite a brief account only (in terms of the completion of life cycle in two hosts)	Recalls details of the life cycle of malarial parasite.	
1.15.	Controlling harmful micro organisms, methods for controlling-drying heating and boiling food.	Analyses various methods of food preservation with reference to their effectiveness.	

S.No.	Concept/Theme	Expected Learning Outcome	Teaching / Learning Activities
1.16.	Prevention of harmful micro organisms, observation, experiment of Edward Jenner, vaccine, immunity, defensive mechanism, antiseptics, sterilisation, pasteurisation.		
<b>2.0</b>	<b>ORGANISATION OF ANIMALS</b>		
2.1.	Organs and organ systems (with organs and functions in man), muscular, skeletal circulatory, respiratory, excretory, reproductive systems (a brief account only)	Sees relationship between structure and functions of animal parts and organs.	Observation of skeleton and various systems of a rat.
2.2.	Locomotion : meaning and need	Analyses properties of living things. Recognises the various types of movements in animals and plants.	
2.3.	Locomotion in lower animals (amoeba, euglena, paramaecium, earthworm and insect).		Paramaecium culture may be done in the lab. The movement of paramaecium may be observed under the microscope. Microscopic study of pond water to observe various protozoans. Observations of school garden/park to see the movements of earthworm, insects etc., Examination of the parts of the hand and its working.
2.4.	Locomotion in higher animals role of muscles, bones and tendons.		
2.5.	Co-ordination-meaning and need.		
2.6.	Role of nerve cells, receptors, effectors and brain in the control of voluntary and involuntary actions.	Analyses the role of brain, spinal cord, receptors and effectors in the control and co-ordination of various activities in man's body.	Prepares a chart showing various receptors and effectors of human body, voluntary and involuntary actions - simple examples.
2.7.	Endocrine glands - hormones (adrenal, pancreas and pituitary glands only).	Infers that these organs though located in different regions of the body, are responsible for the co-ordination of some physiological activities of the body through the action of hormones.	Prepares a chart to show how pituitary is the master gland.
<b>3.0</b>	<b>NUTRITION &amp; HYGIENE</b>		
3.1.	Food.		Observation of predation, examination, of dentition and modification of forelimbs (monkey).

S.No.	Concept/Theme	Expected Learning Outcome	Teaching / Learning Activities
3.2.	Methods of procuring food (monkey) flesh-eating animals, mosquito.	Recognises the various methods employed by animals to procure food.	Prepared slides-mouth parts of mosquito : observation of flesh eating animals.
3.3.	Fate of food inside the body.	Recognises the changes that take place to food in our body.	
3.4.	Ingestion, digestion, absorption. Digestive system in an animal.	Recalls the various steps involved in nutrition of any animal.	Students prepare a chart on the role of enzymes in digestion. Demonstration of the digestion of starch by salivary enzyme amylase.
4.0.	<b>REPRODUCTION, INHERITANCE &amp; EVOLUTION</b>		
4.1	Origin of life-abiogenesis and biogenesis.	Infers that reproduction is the key process by which a new generation comes forth and life comes only from life.	Listing out the genealogy of students. Demonstration of meat - fly experiment.
4.2.	Non-living to living elements, condition of prebiotic earth, compound formation of substances, cell formation.	Analyses the theories of origin of life on our ancient earth.	
4.3.	More complex forms of life (organic evolution).	Recognises the various levels of organisation noticed in animals and plants. Analyses the theory of organic evolution.	Preparation of tree of evolution.
4.4.	Extinct forms of life; remains of the past life.		Visit to a museum to see fossils.
5.0.	<b>ORGANISMS &amp; ENVIRONMENT</b>		
5.1.	Population and food; factors contributing to the increase of human population.	Gets sensitized to population hazards.	The teacher may prepare a histogram chart of population growth of different states of India and their annual production of particular crops like paddy & wheat.
5.2.	Reproductive rate; over production.		
5.3.	Increase in birthrate against deathrate.		
5.4.	Lack of natural control.		
5.5.	Effect of over population.	Realises that means to control human population exist today.	Submission of cuttings of advertisements in newspapers on family planning.
5.6.	Scarcity of space and food.	Identifies population problems in the social context.	
5.7.	Wild life and conservation.	Develops awareness of the need for wildlife conservation.	Visit to zoo, sanctuary or refuge to know the efforts taken by Government to conserve wild-life. Making the students to celebrate wild life week by conducting essay competitions, painting competitions, painting
5.8.	Wildlife in Tamil Nadu and India.		

S.No.	Concept/Theme	Expected Learning Outcome	Teaching / Learning Activities
5.9.	Appreciates the value of wildlife.		competitions, oratorical competitions etc., on wild life and to know their value to preserve them. Administering the oath after asking the students to assemble 'in a place.
5.10.	Methods of preserving our wildlife.		
5.11.	Wildlife day India and the oath.		
6.0	<b>ECONOMIC ZOOLOGY</b>		
6.1.	Useful animals-honey bees; composition and uses of honey; silkworms-poultry-egg and meat.	Recognises the multivarious uses of animals.	Observes the maintenance of beehive to understand the importance of apiculture. Visits a poultry farm and observes the management. Collecting and preserving the different stages in the life history of silk worms.
6.2.	Animal husbandry-breeding and feeding.	Infers that domestic animals need to be cared. A good breed of cattle with proper feed will yield more milk.	Observes a dairy. Exhibits a chart showing different dairy breeds.
6.3.	Types of cattle, dairy breeds, drought breeds, feeding practices, food habits, shelter, care.	Recognises existence of various types of cattle in dairy breeds.	
6.4.	Sheep Food and shelter uses; process of removal of wool, quality of wool.	Recognises the different uses of sheep	Observation of wool with the help of magnifying lenses, recording the methods of processing of wool.

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ACC NO- 15344

# 1. Diversity of living organisms

*Living World - variety of living things - (size, shape, micro and macroscopic, habits and habitats) common features of all living things - levels of organisation - classification of organisms (need - utility- basis of classification) - major groups of animals (invertebrates, vertebrates) - microorganisms - spreading of microbes - direct contact (air, water, insects) - carriers - (vectors) - (life history of malarial parasite) methods of controlling harmful microorganisms - ( Edward Jenner, vaccine, immunity, defensive mechanism, antiseptics, sterilisation, pasteurisation).*

## 1.1. Living world

Anything that lives, such as a plant, man, a bacterium, is an *organism*. Organisms, small and large, show wide variations in their structure and ways of life. In this unit, you will study a few selected examples of microorganisms and macroorganisms that show different patterns of organisation and life.

### VARIETY OF LIVING THINGS WITH REFERENCE TO SIZE AND SHAPE

The variety of animal life is quite staggering and is shown by more than a million species that walk, crawl, hop, swim, fly, or even stay fixed to one spot. These are found in every nook and cranny on earth. They vary in size from about 1/800 of an inch long (e.g., the malarial parasite) to about 100 feet long (e.g., the blue whale). If we study the animal kingdom carefully, we realise that each animal's size, shape, colour and form, is beautifully adapted to the living conditions it is found in.

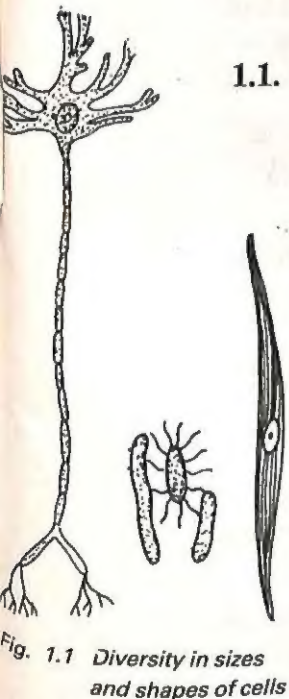


Fig. 1.1 Diversity in sizes and shapes of cells

**Activity 1:** *Select any two different living organisms. Study these carefully and make notes about its size, shape, colour, etc. Write a short paragraph to show how they adapt their lives to the surroundings they live in.*

All living organisms are made up of either a single cell or groups of cells. It is difficult to imagine that all living organisms, from tiny single-celled animals like the amoeba to the largest, most complex animals like the elephant and man, basically, carry out the same life functions, i.e., reproduction, digestion, excretion, etc. The difference is, that while in simpler animals, a single cell performs all the functions, in complex, multi-cellular animals, which have thousands, millions or even billions of cells, different cells perform different functions. There is a division of labour and separate cells group together and are specialised to do one particular function.

## **Microscopic and macroscopic organisms**

### **MICROSCOPIC ORGANISMS—HABITS AND HABITATS**

#### **AMOEBA**

**Habitat :** The amoeba is a microscopic organism that lives in mud or on submerged water plants in fresh water ponds, running streams and ditches. It is found in plenty in ponds and ditches where there is a great deal of decay of organic compounds.

**Activity 2:** *Get a sample of ditch-water. Take a petri-dish and pour this sample into it and observe it under the microscope. Identify the microorganisms you see with the help of your teacher.*

**Structure:** Under the microscope, the amoeba appears as an irregular, colourless mass of *protoplasm*. It changes its shape constantly as it puts forth and withdraws the finger-like projections, called *pseudopodia* or false feet, which it uses for locomotion and feeding. The protoplasm of amoeba is not structureless. It is organised in its own way. It has a *nucleus* at the centre, surrounded by a mass of *cytoplasm*. It has a *selectively permeable* outer limiting membrane called the *plasmalemma*. This retains the *cytoplasm* within it. Beneath this, there is a layer of dense and transparent *ectoplasm* which protects the inner parts. The central portion, which is the main part of the body, is the granular and more fluid *endoplasm*. However, the distinction between ectoplasm and endoplasm is not permanent.

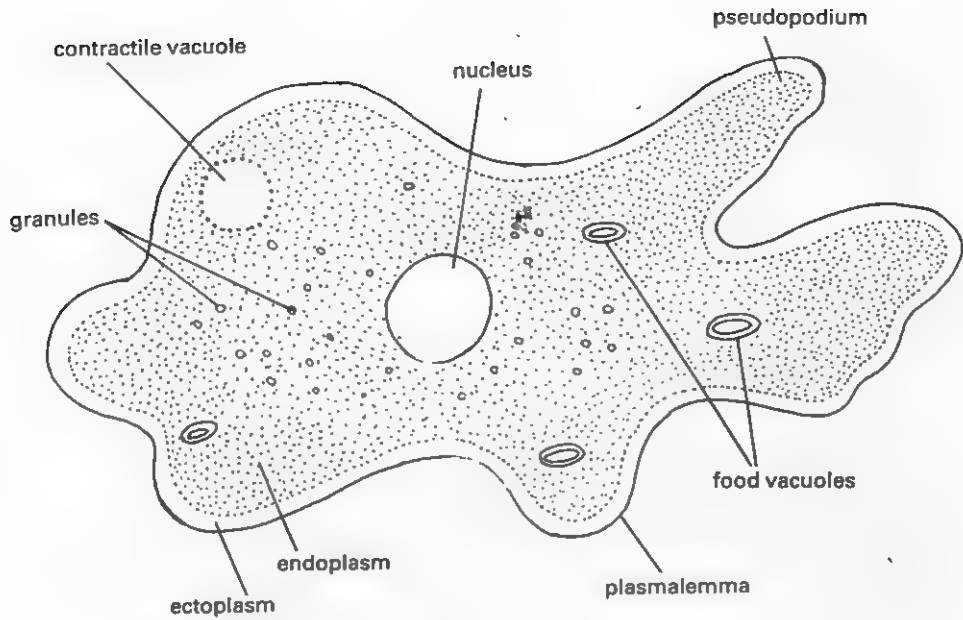


Fig. 1.2 Amoeba

At the centre of the endoplasm is a small disc-like nucleus. It controls the different parts and their functions and is responsible for reproduction. Within the endoplasm are numerous *food vacuoles* enclosing the food in different stages of digestion. There is a single, large vacuole called the *contractile vacuole*, towards the outer region of the endoplasm. This is mainly responsible for regulating the amount of fluid in the body. Thus, though the amoeba is a simple, single-celled animal, it conducts almost all the physiological activities shown by other complex animals.

## PARAMECIUM

*Habitar:* This is also a protozoan, but it is a little bigger than the amoeba and can be seen by the naked eye as a speck. It has a definite shape and because it resembles a slipper, it is often called the '*slipper animalcule*'.

*Structure:* The body of a paramecium is elongated and cigar-shaped with a blunt anterior end and a pointed posterior end. The whole body is covered by a thin skin called the *pellicle* from which numerous thread-like structures called cilia project. On the flattened ventral (front) side is the *oral groove* which runs backwards, along

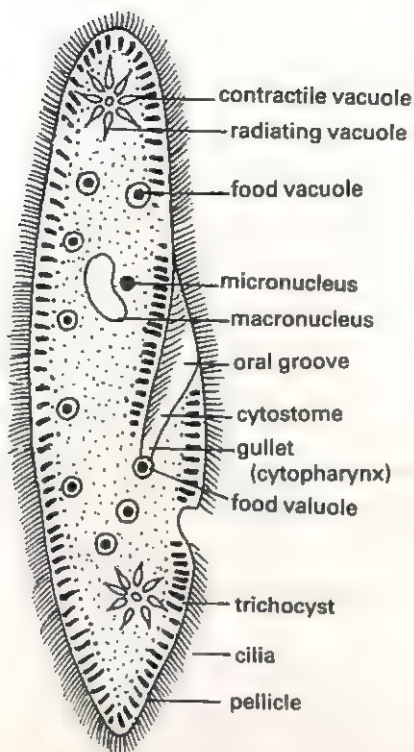


Fig. 1.3. *Paramecium*.

the right side, from the anterior end upto about a third of the body. The oral groove ends at the *cytostome* or the mouth. The cytostome leads into a tubular structure called the *gullet* or *cytopharynx*. This continues into the endoplasm where food vacuoles are formed.

Beneath the pellicle is the *ectoplasm* or *cortex*. Within this and scattered throughout the body are numerous spindle-shaped *organelles* called *trichocysts*. When a paramecium is irritated, long threads containing poison are ejected from the trichocysts to paralyse the victim. Therefore, they are said to be *defensive organelles*. They are also used to anchor the body to the substratum while the animal is feeding on other organisms.

Within the cortex is a central zone of the endoplasm, the *medulla*. This contains two nuclei, a large *macronucleus*, that controls the metabolic activities of the organism and a smaller *micronucleus*, that controls reproduction. There are two *contractile vacuoles*, one in the anterior (front) half of the body and the other in the posterior (lower) half. Connected to these are many *radiating vacuoles*. Numerous *food vacuoles* are also present in the endoplasm.

## MACROSCOPIC ORGANISMS — HABITS AND HABITATS

While some plants and animals have an *acellular* (single-celled) organisation, many of them have a multicellular organisation. These many-celled or multicellular organisms are not only numerous, but are also varied with different patterns of organisation. Some of these are simple and others are complex.

### HYDRA

*Habitat:* The hydra is a multicellular, macroscopic animal with a simple organisation. It lives in clean freshwater ponds and lakes, attached to stones and plants.

**Activity 3:** Observe a prepared slide of hydra under a microscope and identify the parts. Draw a neat labelled sketch of what you see.

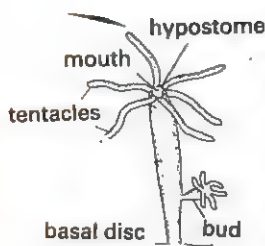


Fig. 1.4 The hydra

**Structure:** The body is cylindrical and measures about a centimetre in length when expanded. It remains attached to the substratum by means of its *basal disc*. At the opposite end of the basal disc is a conical projection called the *hypostome* with a mouth at its centre. Many hollow, long structures called *tentacles* radiate, from the base of the hypostome. Usually, there are six tentacles, each having several stinging cells. The adult hydrae have one or more *buds* and in addition may also bear the reproductive organs, the *testes* and *ovaries*.

## 1.2 Common features of all living organisms

We refer to living things as living organisms because of their complex nature. Most living organisms can be easily distinguished from non-living objects. Some will need to be studied in great detail to determine whether they are really living (e.g., the eggs of birds). But, as we study them closely we can easily discover the features of living organisms. There also are a few organisms like viruses, which cannot be clearly classified in spite of a great deal of study. Even today, no one can say whether they are actually living or non-living.



Fig. 1.5 An egg



Fig. 1.6 Virus particles

Life is defined as a series of reactions which gives living beings the power to grow, maintain themselves and reproduce. These are the common features by which you can distinguish the living from the non-living.

### 1. DEFINITE SHAPE AND SIZE

Every living being possesses a definite shape and size, and so is called *morphous* (having form) in comparison to a non-living object which is usually *amorphous* (without a fixed form and shape). (Non-living crystals which have a definite form are exceptions.) It is this property which helps you to picture an organism when you think of it.



Fig. 1.7 Non-living organisms are amorphous

### 2. CHEMICAL COMPOSITION AND ORGANISATION

A chemical study of living organisms shows that their bodies are composed of the same elements that make up the non-living world — mainly carbon, hydrogen, oxygen and nitrogen. Other elements like, calcium, phosphorus, sodium, potassium, iron, copper, sulphur, etc. are

found in traces. However, in living organisms these elements form extremely complex compounds. A complex mixture of these compounds forms *protoplasm* which is the essential feature of all living things.

The body of a living organism is made up of thousands of tiny units called cells. There are different kinds of cells to perform different functions. This may be further grouped together to perform connected functions. Thus, while living organisms have a complex structure, non-living objects are not so complex in structure and organisation.

### 3. METABOLISM

The sum-total of all the chemical changes which go on inside the body of an organism is called *metabolism*. This consists of two broad types of chemical reactions:

*Anabolism*: This is a series of chemical reactions that form complex substances from simpler substances resulting in the formation of protoplasm and therefore growth, (e.g., photosynthesis).

*Catabolism*: This is a series of chemical reactions, that break down complex substances, resulting in the release of energy, (e.g., respiration).

*Nutrition, respiration and excretion* are all different kinds of metabolic activities that are carried on by living organisms.

*Nutrition*: This is the process of nourishing the body. In animals, nutrition consists of a number of steps like, *ingestion* (taking in of food), *digestion* (conversion of food into a form that the body can use), *absorption* (when digested food is absorbed by the blood), *distribution* of absorbed food, *assimilation* (conversion of absorbed food into protoplasm) and *egestion or defaecation* (throwing out of undigested food matter).

The energy from the sun is trapped by green plants during photosynthesis and is stored as food. Animals consume this food and use it for providing energy for various activities like the repair of worn out tissues and for growth.

**Activity 4:** Prepare a poster to show different types of nutrition in plants and animals. Give suitable illustrations for each example.

**Respiration:** This is the process of oxidation of food within the cells which results in the release of energy stored in it.

**Excretion:** This is the process by which waste products produced in the cells are thrown out.

None of these metabolic activities take place in non-living objects.

#### 4. ADAPTATION

The life of an organism is influenced by its immediate surroundings, the environment. Every living organism is modified to help it to live in harmony with its surroundings. An example of this is the thick fur of animals belonging to the polar regions. Most birds have stream-lined bodies and insulating feathers to help them to fly. In winter, a toad digs a burrow in the ground and remains inactive inside it to avoid the extreme cold. This process is called *hibernation* and is an example of a short-period adaptation.



Fig. 1.8 The kangaroo rat

Another interesting example of adaptation is the *Kangaroo rat* which lives in some deserts. It does not drink water and lives only on dry seeds and metabolic water. It has specialised kidneys which can concentrate its urine and thus it avoids loss of water.

In certain cases, adaptation may be a long-term process involving gradual changes through several generations. These changes result in the evolution of a new species.

Non-living things cannot adapt themselves.

#### 5. MOVEMENT

All living organisms show movement. Animals generally move the whole body from one place to another, (exception - *sponges*). Some aquatic plants (e.g., *chlamydomonas*) move, too. The majority of plants, however, are fixed. Though they may show movement of some parts (e.g., sleep movements of leaves, opening and closing of flowers, etc).



Fig. 1.9 *Chlamydomonas*

The movement shown by living organisms comes from within themselves and they move for various reasons, which may be for food, shelter, or to avoid unfavourable conditions in their surroundings. The movements of living organisms are caused by internal or vital forces.

Some non-living objects (e.g. a motor car) can move but they require an external force or source of energy. Such types of movements are called *induced movements*. Non-living objects will never move on their own.

**Activity 5:** Observe preserved specimens of sponges and corals in your laboratory or get some pictures from your library. Collect information on their habitat.

**Activity 6:** Collect pictures of sedentary organisms (those attached to substratum) such as sea anemone, hydra, etc. Write short notes on the different ways by which these animals move. Compare their movements.

## 6. IRRITABILITY (RESPONSE TO STIMULUS)

Irritability, i.e., the ability to respond to stimuli is the basic property of protoplasm itself. Any change in an organism's external environment is called *stimulus*.

Undistributed branch

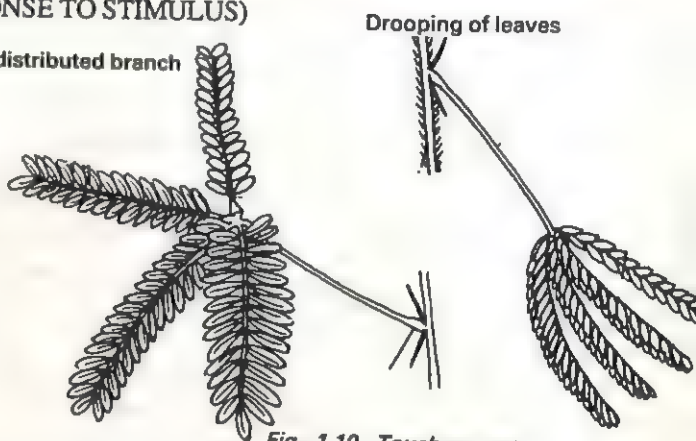


Fig. 1.10 Touch me not

Organisms respond to various stimuli in different ways. The reaction of the organism is its *response*. The feeling of pain on being pricked, running away from the place of danger, etc. are examples of irritability.

Plants, too, respond to the stimuli of water, light, heat, etc. Touch-me-not (*Mimosa pudica*) has been so named because of its property of quickly folding its leaves when disturbed. You may also have seen stems bending towards light.

**Activity 7:** Place a potted plant near a window (or in a phototropic chamber) and observe it for two or three days. Make a sketch of what you see. Turn the pot around and observe it for a few days again. What can you conclude from this experiment?

**Activity 8:** Make up an experiment to show hydrotropism, i.e., response of plants to the stimulus of water.

Some insectivorous plants like *Nepenthes* (pitcher plant), *drosera* (sundew), etc. that grow in soil deficient in nitrogen, trap, kill and

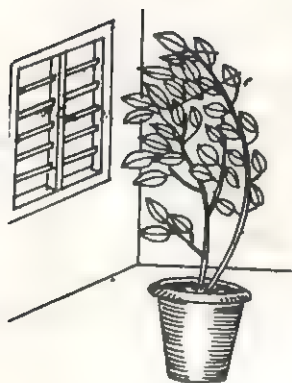


Fig. 1.11 Phototropism

digest insects to obtain a part of the nitrogen they require for growth. In these plants, the response is more apparent.

Non-living objects do not respond to stimuli.

## 7. GROWTH

Growth is the permanent increase in the size of an organism. Every living being grows. For example, a pup grows into a dog, and a baby into an adult human being.

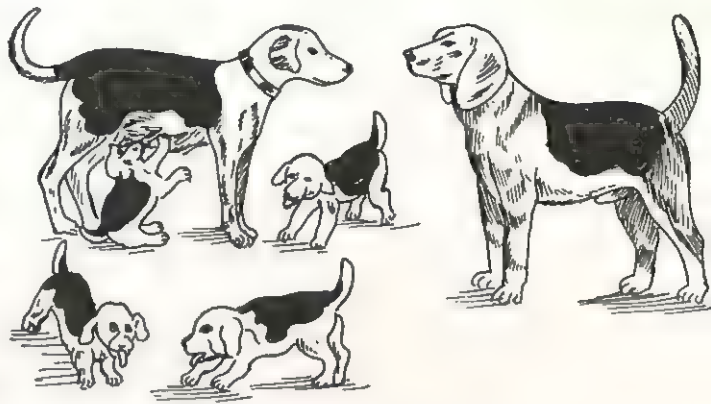


Fig. 1.12 Growth: dogs and pups

This growth is always internal. It is produced by the formation of new materials from the food taken in by the organism. Such a method of growth is called *intussusception*, i.e., the increase in size comes from within. After a stage, an organism usually stops growing. In plants growth continues indefinitely (e.g., trees).

Non-living objects like crystals or stones can 'grow' or show increase in size but this happens by the addition of similar material to their outer surface. This kind of growth is known as *accretion*.

**Activity 9:** Sow a few bean seeds in a small pot and observe the growth of the seedlings. Measure it with a scale or a measuring tape everyday. Keep a record of this.

**Activity 10:** Suspend a big crystal of common salt in a saturated (strong) solution of common salt. Leave it for a few days and observe its growth. Draw what you see.

## 8. REPRODUCTION AND LIFE-CYCLE

You may have seen chicks that have just hatched out of eggs or are a few days old. They are small, with a soft feathery covering. Though they are steady on their legs, they take food under direction from the mother hen. They will take a few months to complete their growth and become adult cocks or hens.



Fig. 1.13 The hen reproduces its own kind

The hens will lay eggs, hatch them and thus raise a new generation of chicks.

All living organisms, after birth, grow up and have the power to reproduce their own kind to continue the species. Non-living things cannot reproduce by themselves.

If you continue to watch the hens that give you eggs, you will see that as they grow old they gradually lose their egg-laying capacity, and finally die. This happens to all living organisms. *Birth, growth, reproduction and death* take place in all living organisms.

These orderly, cyclic changes are never shown by non-living objects.

In conclusion, it may be said that living organisms share all, or most of the features mentioned above. Non-living objects may show only a few of these features. Thus a small piece of sodium may 'move' on the surface of water, crystals will 'grow' in saturated solutions and a moving car will 'respond' when the accelerator is pressed. Yet can we consider them to be living?

*Activity 11: Dogs give birth to pups. Life comes from pre-existing life. How do you think the first living organism came into being? Keep your mind open to ideas and information about it.*

### 1.3 Levels of organisation

In all living organisms the physical basis of life is protoplasm. This exists as organised cells which, in higher organisms are specialised differently to form different groups of cells called *tissues*. These tissues are specially adapted to perform particular functions. In man and other higher animals, the specialisation of cells does not stop at the tissue level. Several tissues come together to perform a special function. An association of different tissues, like the stomach and heart, that together perform a special function is called an *organ*. Thus the heart consists of *muscle tissue, epithelial tissue, connective tissue, nervous tissue* and *vascular tissue*. Though each tissue is specialised, collectively they form one distinct organ, whose function is to pump the blood and keep it circulating. Again several organs may work together to form an organ system.

## 1.4 Classification of organisms

The great diversity among living organisms makes it difficult for anyone to study them all. For centuries, man has tried to arrange them into some kind of logical order or grouping to understand them fully. The branch of biology that deals with the identification, naming and classification of organisms is called '*taxonomy*'.

The earlier biologists could not find a satisfactory system of classification. Later a Swedish biologist named Carl von Linnaeus (1707–78) was the first to devise a satisfactory system of classification. He is known as the 'father of modern classification'. His system was based on external form of organisms. He, correctly, grouped together animals that resembled each other. For instance, lions, tigers, and domestic cats belong to one group of animals, *Felidae*. Other biologists have been and still are improving the system of classification, making use of the other related fields of biology, such as *morphology*, *physiology*, *embryology*, *genetics*, etc.



Fig. 1.14 Carolus Linnaeus

### The need for classification

An organism may be known by a different name to different people depending upon the language spoken, locality, etc. For example, the domestic cat is known by different names to people in different states of India, as well as in different parts of the world. To avoid such confusion, organisms that have been identified and studied are given scientific names, consisting of two parts, a *generic* name or *genus* and a *specific* name or *species* comparable to our own surname and first name. Thus, the tiger is *Felis tigris* and the cat, *Felis domestica* (both belong to the same family *Felidae*). This system of naming organisms using the *generic* and *specific* names is known as the *binomial system of nomenclature*.

#### Binomial nomenclature of some common animals

Common name	Generic name	Specific name
1. Pigeon	Columba	livia
2.. Frog	Rana	tigrina
3. House fly	Musca	domestica

## UTILITY OF CLASSIFICATION

There are 1.2 million forms of life that have been discovered on earth. Also, there were many other kinds of plants and animals that once existed but are now extinct. You can imagine the confusion and chaos if we were to study such a wide range of organisms one by one. To make this study simpler, scientists put similar organisms into groups and developed the present system of classification.

## UNITS OF CLASSIFICATION

The basic unit of classification is the species. A species is a group of similar individuals which differ from all other organisms in one or more ways. Members of one species can breed among themselves. Usually, the members of one species cannot breed with the members of a different species. For example, a horse cannot breed with a lion.

Several species are often related to each other by some common characteristics. In such cases, they are grouped into a larger unit called a *genus*. For example, the tiger (*Felis tigris*), the lion (*Felis leo*), the leopard (*Felis pardus*) and the house cat (*Felis domestica*) all belong to the genus *Felis*. In the same way many related genera (plural of genus) are placed in a larger unit called the *family*. In turn, families form an *order*; orders form a *class*; classes form a *phylum*; and phyla form a *kingdom*. Thus a living organism belongs to a species, a genus, a family, an order, a class, a phylum and a kingdom.

Man can be classified as follows:

Species	-	<i>sapiens</i>
Genus	-	<i>Homo</i>
Family	-	<i>Hominidae</i>
Order	-	<i>Primates</i>
Class	-	<i>Mammalia</i>
Phylum	-	<i>Chordata</i>
Kingdom	-	<i>Animalia</i>

### 1.6 Basis of classification

The entire animal kingdom can be divided into two major groups based upon the presence or absence of a backbone. Those animals which have a backbone or vertebral column supporting the body are called *vertebrates*, e.g., cats, lizards, fishes, birds, human beings, etc. Those

animals which have no backbone are called *invertebrates*, e.g., insects, worms, amoeba, snails, etc.

Another basis of classification which again divides the entire animal kingdom into two, depends on the number of cells that make up a body. All unicellular, or single-celled animals are called *protozoans* and all multicellular animals are called *metazoans*.

*Activity 12 : Examine preserved specimens of worms, cockroaches, grasshoppers, spiders, fish, frogs, lizards, parrots, rats, etc., or find pictures of them in your library. Classify them into vertebrates and invertebrates.*

## 1.7 Major groups of animals

Over million species of animals are known today. The major phyla of the animal kingdom are as follows:

### ANIMAL KINGDOM

Invertebrates		Vertebrates
Protozoa (unicellular) (e.g., amoeba, paramecium)	Metazoa (multicellular) 1. Porifera (e.g., sponge) 2. Coelenterata (e.g., hydra, jellyfish) 3. Platyhelminthes (e.g., tapeworm, liverfluke) 4. Nematelminthes (e.g., hookworm, threadworm) 5. Annelida (e.g., earthworm, leech) 6. Arthropoda (e.g., spider, prawn) 7. Mollusca (e.g., snail, octopus, etc.) 8. Echinodermata (e.g., starfish, sea urchin)	Chordata (with vertebral column) 1. Pisces (e.g., rohu, pomfret) 2. Amphibia (e.g., frog, toad) 3. Reptilia (e.g., lizard, snake) 4. Aves (e.g., pigeon) 5. Mammalia (e.g., man, rabbit)

## 1.8 Animals without backbone – invertebrates

You have learnt that all animals without backbones are classified under the sub-kingdom invertebrates. The essential features of the major groups of invertebrates are :

### 1. PROTOZOA

These microscopic organisms with single-celled bodies live chiefly in water and soil. Some of them, like the malarial parasite, live as parasites within the bodies of other animals. Among the animals that live on earth, the protozoans are the simplest in organisation, and yet they perform all the essential activities like digestion, respiration, etc.

### 2. PORIFERA

Sponges which are multicellular organisms, are usually found, fixed on an underwater object in sea water, and occasionally in fresh water.

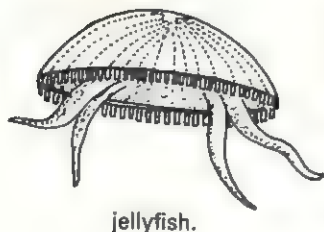
The body of a sponge consists of numerous pores. Water seeps into the central cavity through these pores, and when this is in excess, it is thrown out from a large opening called the *osculum*. The body wall is strengthened by a framework of small *spicules* (hard fibre-like structures).



Fig. 1.15. *Sycon* (sponge)

### 3. COELENTERATA

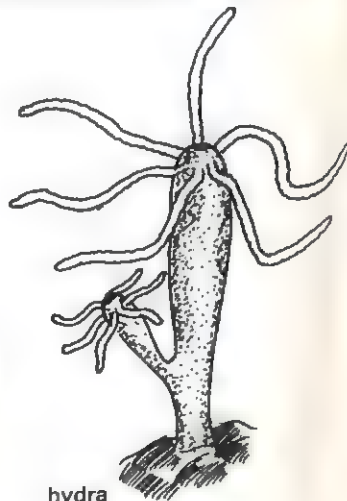
Coelenterates have bodies consisting of a tube-like central cavity known as *coelenteron* where food is digested and circulated. The cavity



jellyfish.



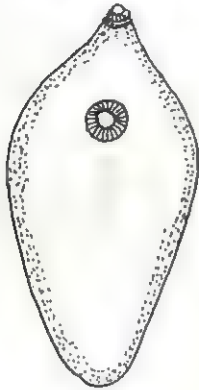
sea anemone



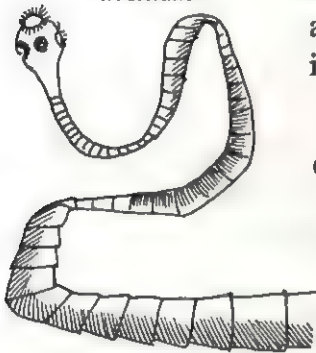
hydra

Fig. 1.16 *Coelenterates*.

is lined by two layers of tissues, the outer, the *ectoderm* and the inner, the *endoderm*. A single mouth, surrounded by tentacles opens at the anterior end. These help to capture and select food. The tentacles along with the ectoderm contain a large number of *stinging cells* which paralyse the prey and also protects them from their enemies.



liverfluke



tapeworm

Fig. 1.17 Flatworms

#### 4. PLATYHELMINTHES

Members of this phylum are commonly called *flatworms*. The majority of them are parasitic (e.g., liverfluke, tapeworm, etc.). A few are free living (e.g., planaria). They have bilaterally symmetrical bodies. Their bodies have special cells called *flame cells* for the elimination of waste products.

The tapeworm lives as a parasite in the intestine of man, attached to the wall of the intestine with suckers and hooks. It absorbs the digested food from the intestine.

Flatworms have an *incomplete digestive canal* with only one opening. They are usually *hermaphrodites*, i.e., male and female reproductive organs are present in the same body.

#### 5. NEMATHELMINTHES

This phylum includes *roundworms* and *threadworms*. The bodies are unsegmented, containing a complete digestive canal with two openings. These worms live freely in water and damp soil and as parasites within the bodies of other animals. A roundworm may be either male or female, but not hermaphrodite, e.g., ascaris, pinworm, hookworm, etc.

#### 6. ANNELIDS

These are segmented worms with bilaterally symmetrical bodies divided into a number of ring-like

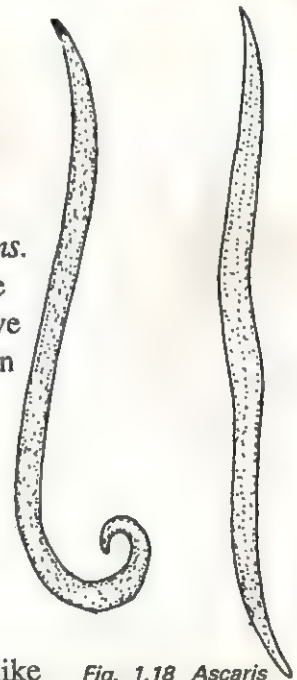


Fig. 1.18 Ascaris

segments. They are found in water as well as in damp soil. They possess a vascular system as well as a well defined nervous system and hence are more complex in organisation. Some animals like the leech, live as external parasites and suck blood from the bodies of higher animals. Others, like the earthworm, live in burrows in the soil.

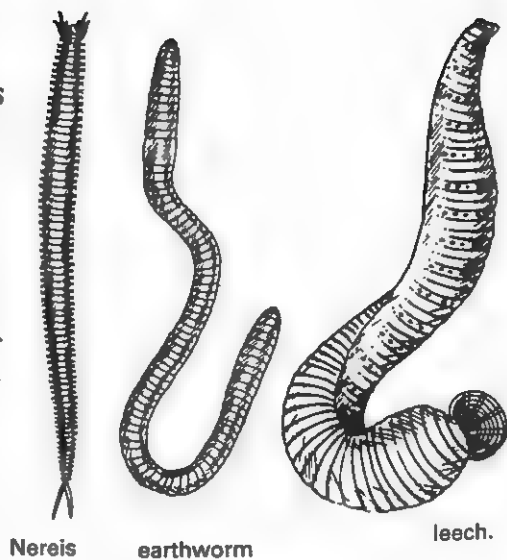


Fig. 1.19 Annelids

## 7. ARTHROPODA

This is the largest number of species of animals. Their bodies are bilaterally symmetrical and segmented. The soft body is covered and protected by an exoskeleton. As the animals grow, the exoskeleton is shed periodically by a process called *moulting*. A special feature of animals belonging to the phylum is that all possess jointed legs, e.g., beetle, housefly, centipede, prawn.

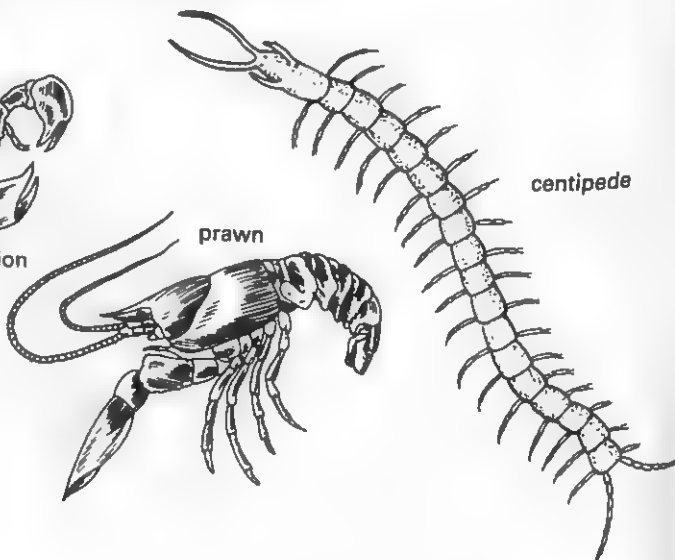
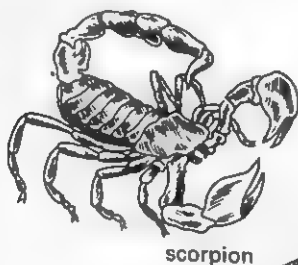
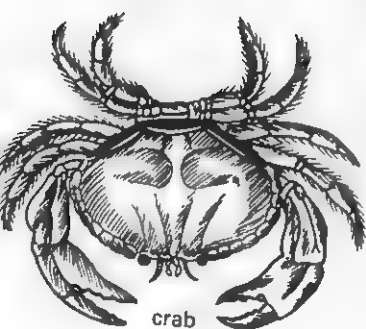


Fig. 1.20. Arthropods

## 8. MOLLUSCA

These animals have shells covering their bodies. They are found in fresh and sea water, and even on land. They have soft, unsegmented

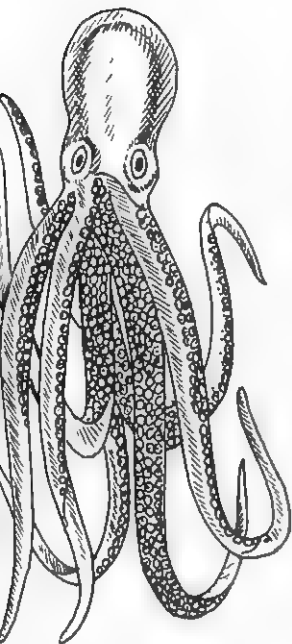
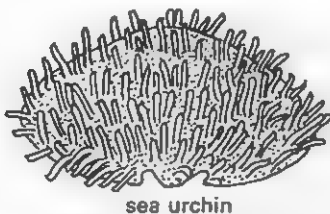


Fig. 1.21 An octopus

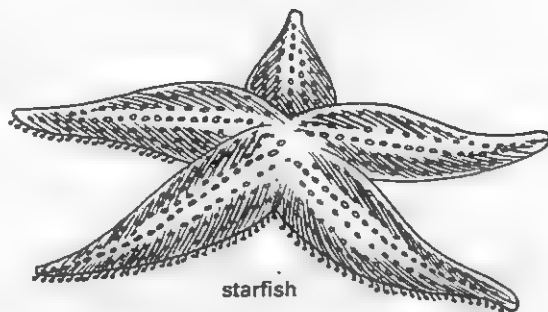
bodies which are protected by a covering called a *mantle*. This covering secretes material containing calcium which hardens to form a shell around the body. Some molluscs have no shell, e.g., octopus. Most molluscs move by means of muscular feet (e.g., snail) etc. etc.

## 9. ECHINODERMATA

These animals have a prickly or spiny skin. They are always found in sea water. Some echinoderms are stationary but most move sluggishly. e.g., sea cucumber, sea lily, starfish, etc.



sea urchin



starfish

Fig. 1.22 Echinoderms

## 1.9 Animals with backbone - vertebrates.

Vertebrates are also diverse in their general habits and structure and yet remarkably similar in having certain basic characteristics. Most important among these is the presence of a backbone, the main supporting skeleton lying in the mid-dorsal axis of the body. The backbone is composed of a series of bones called the *vertebrae* and hence the name vertebrates. In the embryo stages, all the vertebrates have another structure, the *notochord*, in place of the backbone.

### PROCHORDATES

There are a few forms which never develop a true backbone but possess only a notochord. For example, the fish-like *amphioxus* possesses a notochord. *Balanoglossus* is also an example of a prochordate.

Prochordates and vertebrates together constitute the phylum chordata.

Those animals that develop a true vertebral column are vertebrates. The different classes which fall into this group are as follows: *pisces*, *amphibia*, *reptilia*, *aves* and *mammalia*.

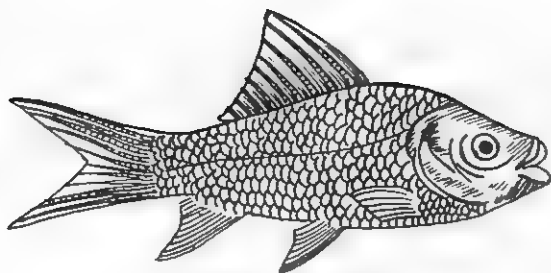


Fig. 1.23 Rohu (fish)

## 1. PISCES

These animals were the first on the earth to have a proper backbone. Fishes have stream-lined bodies divided into head, trunk and tail. They have a covering of scales which

may be partially or completely embedded in the skin. The body has a number of *fins*. All fish have *lateral line sense organs*. They have a pair of nostrils, a pair of eyes, a mouth situated at or near the tip of the head and 5-7 pairs of *gill slits*. These gill slits are covered by a gill cover known as the *operculum*. Fishes are both viviparous (give birth to young ones alive) and oviparous (egg laying). They are cold blooded. The class pisces includes both cartilaginous fishes like the shark and bony fishes like the mullet.

**Activity 13:** Observe a bony fish and a cartilaginous fish and try to identify the different parts.



Fig. 1.24 Frog

## 2. AMPHIBIA

Amphibians have characteristics of both aquatic and terrestrial animals. They live in or near water for the purposes of respiration, breeding and feeding.

Amphibians have a moist and glandular skin and two pairs of limbs. Their body temperature changes according to the environment. Such animals are

called *poikilotherms*. Most amphibians remain in deep lakes or moist soil during winter. The phenomenon is known as *hibernation* or winter sleep. A few amphibians are sluggish during the hot periods and they rest in moist, shady or cool places. This habit is called *aestivation*. Most of these animals have two pairs of limbs. The heart has three chambers, namely two auricles and one ventricle. They are oviparous.

**Activity 14:** Observe a frog and a toad and try to identify their external features.



Fig. 1.25. Lizard

### 3. REPTILIA

Reptiles resemble amphibians because they are also cold blooded or poikilothermal. They differ from them in having a cornified, dry skin, which bears scales. Some are covered over by a hard but porous shell. The limbs are pentadactyl (having five digits). They bear terminal claws. Most reptiles lay eggs. Respiration is *pulmonary* i.e., by lungs. In most reptiles locomotion is carried out with the help of two pairs of limbs. The heart has two auricles and a ventricle which is imperfectly divided into two.

**Activity 15:** Observe a house lizard or a garden lizard and draw a labelled sketch of what you see.

### 4. AVES

Birds are *terrestrial* (living on land) or *arboreal* (living on trees). They are characterised by the presence of an exoskeleton of feathers, and their ability to fly has helped them to live in places all over the world. There are four types of feathers—*contour feathers*, *down feathers*, *filoplumes* and *brisiles*. The forelimbs are modified into wings and the tail is modified to help it to steer its body in flight. The hindlimbs end in claws and are modified for perching, walking or swimming.

The body of a bird is *streamlined*. It is also light because of the presence of *air sacs*. Birds have a regular body temperature, hence are warm blooded or *homoiothermal*. Teeth and ears are absent. The mouth is enlarged into a beak. The eyes are well developed and have a *nictitating membrane* (third eyelid). The neck is flexible.

Respiration is by lungs which have air sacs attached to them. The heart has four chambers, two auricles and two ventricles.

All birds are oviparous and sexes are separate.

### 5. MAMMALIA

All mammals feed their young with milk from special glands in the skin called *mammary glands*. This is why they are called mammals. All mammals possess hair on their body. They are warm blooded. The skin has sweat glands for excretion and regulation of body temperature. The heart has four chambers. The brain is highly developed. The majority of mammals have two sets of teeth called *milk teeth* and *permanent teeth*.

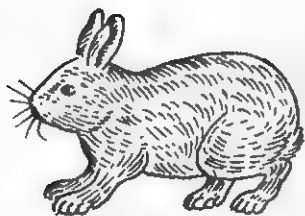


Fig. 1.26 Rabbit

These are embedded in sockets. There is usually an external ear or pinna on either side of the head. The *coelom*, or body cavity is divided into two parts by a partition called the *diaphragm*. Respiration is only through the lungs. There are two pairs of *pentadactyl* limbs ending in nails. These are modified differently in different groups. Most mammals are viviparous.

#### 1.10. Microorganisms – (protozoans, bacteria, viruses)

Many microorganisms live inside the body of hosts and cause dreadful diseases. You may already heard of two such microorganisms, *viruses* and *bacteria* which cause diseases like polio, smallpox, dysentery, pneumonia, etc. Besides these, certain species of protozoan microorganisms live as parasites inside the body of man and other animals and cause serious diseases. Three common disease producing protozoans are *Plasmodium*, *Entamoeba histolytica* and *Trypanosoma gambiense*.

*Plasmodium*: This protozoan causes the disease malaria. It is transmitted from person to person by the bite of the female anopheles mosquito. When a person suffers from malaria he/she gets high fever and shivering which occurs every 48 or 72 hours.

*Entamoeba histolytica*: This is another protozoan parasite which causes amoebic dysentery. This disease spreads from the faeces of the infected person. The patient gets severe cramps in the abdomen and has repeated loose motions. His stools contain large amounts of blood and mucus.

*Trypanosoma gambiense*: This protozoan parasite causes the dangerous disease, 'sleeping sickness'. The protozoan is transmitted by the bite of the *tsetse fly*. Common symptoms are fever, headache, insomnia (inability to sleep) and loss of concentration. In severe cases, the brain is seriously damaged and the patient may die after convulsions and coma.

**Activity 16 :** Observe some prepared slides of protozoan parasites such as *Plasmodium*, *Entamoeba*, *Trypanosoma gambiense*, etc. Note the structure of each and study how it is adapted to live as a parasite.

**Activity 17:** Complete the following chart. Try to find out the information from a library or a doctor you know.

<i>Disease</i>	<i>Caused by</i>	<i>Symptoms</i>	<i>Treatment</i>	<i>Control</i>
Malaria				
Sleeping sickness				
Amoebic dysentery				

### 1.11. Spreading of microbes

You are already aware that several microorganisms cause diseases in man. These microbes are found abundantly in air, water, soil, etc. In the right conditions they increase and multiply rapidly and if sufficient precautions are not taken they can cause widespread epidemics and man would have very little chance of survival.

It is strange that these microbes which are very tiny can attack and even kill large organisms like man. What makes this possible is that they are able to multiply at a staggering rate—within a few hours they can increase their number by over a million and they can withstand all sorts of conditions and can even develop resistance to new preventive measures developed by man.

Man has been fighting an endless battle against microbes for centuries. It is satisfying to note that we have succeeded in developing several new methods of controlling the spread of microbes and even totally destroying them in some cases. But the fight against the microbes has to continue relentlessly as they are a constant challenge to the survival of mankind itself.

### 1.12 Direct and indirect contact

Some *pathogenic* (disease producing) microbes live in close connection with the person infected. They need the bodies of living individuals to thrive and propagate their species. The germs cannot survive in an *inanimate* environment outside the body of the host. The spreading of disease or transmission of germs may take place in one of the following ways.

#### A. DIRECT TRANSMISSION:

Many infectious diseases such as smallpox, typhoid, pneumonia, etc. are spread by direct transfer of the germs from the patient to another person through close contact. Certain diseases such as influenza, cold and tuberculosis are transmitted through droplets expelled from the nose and mouth during coughing, sneezing, talking and vomiting. A vast number of droplets expelled by patients during sneezing may be inhaled by persons nearby who may become infected. Direct transmission of pathogenic microbes from mother to child may take place before birth through the placenta.

#### B. INDIRECT TRANSMISSION THROUGH FOMITES

Some microbes can remain outside the body of the patient and may be transmitted through inanimate objects, such as toilet articles, bed-pans, drinking glasses and towels that are infected by the discharges of a patient. Such types of inanimate, contaminated objects are known as *fomites*.

#### C. TRANSMISSION BY ANIMALS

Many animals, such as mammals, birds, ticks, mites and insects, transmit a large number of diseases.

### 1.13. Carriers of diseases (vectors)

Germ-carriers are known as *vectors*. Most insects are vectors. They may be *passive carriers*, where the germ of the disease may settle on their wings, legs, etc. or pass out unaffected in their waste matter. When these insects come into contact with a human being or any foodstuff, they could leave the germs there. One good example of this is the housefly. Diseases like smallpox, local sores, diseases of the eyes and cholera are spread in this manner.

The insects may be *active carriers* in which case they serve as an alternative host to the germs and destroying them would mean the end of the disease. Examples of insect vectors are *rat-fleas* which carries germs of plague, *tsetse fly* which carries germs of sleeping sickness, *Anopheles mosquito* which carries germs of malaria and *sandfly* which carries germs of *kala azar*.

**Activity 18: Collect pictures of insect-vectors. Write a short note on each vector and how it transmits disease.**

#### **1.14. Life history of a malarial parasite (a brief outline - completion of life cycle in two hosts)**

You are already aware that parasites live in a host's body and adapt their lives to its way of living. Some animal parasites do not complete their life cycle in one host but require two or more hosts to do this. Having two hosts is actually an advantage to a parasite because if one host dies, the animal may continue to live in another form in the second host.

The *Plasmodium vivax* (malarial parasite) completes its life cycle in two stages—the asexual stage where it lives in the *primary host*, man and the sexual stage where it lives in its *secondary or intermediate host*, the female *Anopheles mosquito*. In this case the *Anopheles mosquito* is also the vector because it carries the parasite to man.

**Asexual stage :** When a female *Anopheles mosquito* carrying the parasite plasmodium bites a man to suck his blood then, along with its saliva it injects into his bloodstream thousands of sickle-shaped forms of plasmodium called *sporozoites*. In this sporozoite stage of its life cycle the parasites can glide about and in approximately half an hour enter the liver cells.

In the liver, the sporozoites divide and multiply asexually in several stages to form *merozoites*. This stage takes about ten days and is called the *incubation period* when the infected person shows no sign of malaria. Finally the merozoites are released into the victim's bloodstream. They enter the red blood cells and continue their asexual cycle of multiplication. This cycle is repeated many times. At the end of each cycle the parasites are released into the blood along with some *toxins* (poisons). Finally, the toxins are carried in the blood to various parts of the body and the patient suffers from chill, shivering and high temperature followed by sweating. The fever may last for 6–10 hours and recurs after every 48 or 72 hours depending on when each new generation of merozoites are liberated into the patient's bloodstream.

**Sexual stage :** After many generations of asexual reproduction in the blood, the merozoites slowly grow large and form two types of

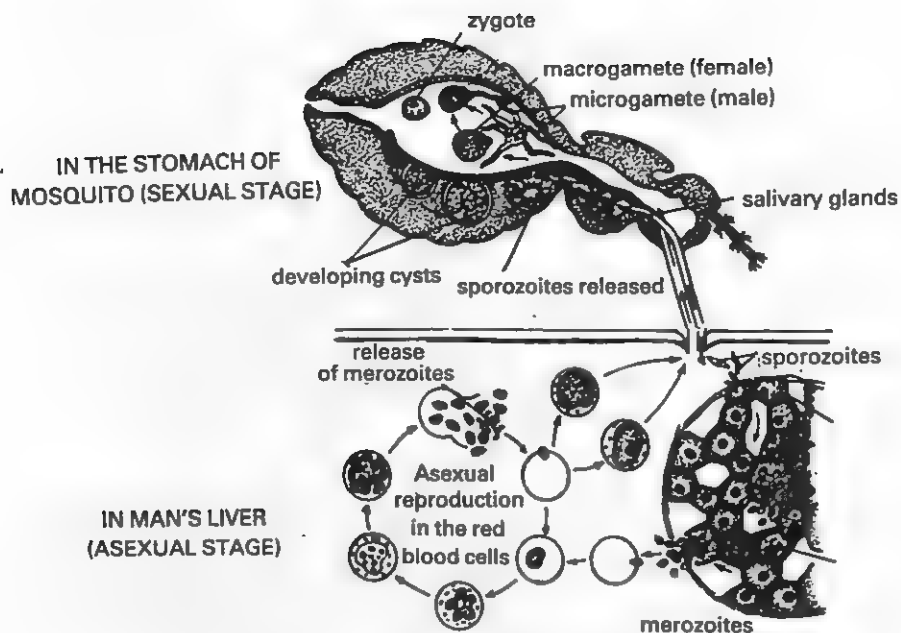


Fig. 1.27. Life cycle of *Plasmodium vivax*.

cells—the male cells (*microgametocytes*) and the female cells (*macrogametocytes*).

These may remain in the human blood for several weeks but cannot develop any further. They now need to be taken into the body of the *Anopheles* mosquito otherwise they begin to slowly die.

At this stage, if they are sucked up along with human blood by the female *Anopheles* they reach its stomach. Here, a series of changes take place in the cells and finally a male cell will fuse with a female cell to form a single new cell called the *zygote*. This develops into *cysts* which penetrate the wall of the stomach of the mosquito. There may be about 50 cysts in the stomach of one mosquito. Here it grows and develops and the slender, spindle-shaped *sporozoite* develops inside it.

Finally, the cyst bursts and *sporozoites* are liberated into the body of the mosquito. They then reach the salivary glands and when the mosquito bites another human being, he may be infected.

Thus the life cycle of the *Plasmodium vivax* shows two stages:

1. An asexual multiplication stage in the liver and blood of man.
2. A sexual stage which takes place in the female *Anopheles*.

**Activity 19 :** Find out the control measures used by the government of Tamil Nadu and by the Central Government to eradicate malaria.

**Activity 20:** 'Control of mosquitoes for prevention of malaria is very important'. Discuss and comment on this statement.

*Plasmodium vivax*, *Plasmodium malaria*, *Plasmodium falciparum* and *Plasmodium ovale* are some of the species of *Plasmodium*.

The oldest remedy known against malaria is *quinine*. It is effective only in killing the early sporozoite stages of the plasmodium. *Mepacrine* is effectively used only against merozoites. *Paludrine* is superior to both as it kills almost all stages, of the *Plasmodium* except the ones in the liver.

## CONTROL OF MALARIA

*Methods of controlling malaria:* 1. sleeping under a mosquito net. 2. killing mosquitos by spraying them with chemicals like D.D.T which are poisonous to mosquitos. (New chemicals are being developed because mosquitos are becoming immune to the ones previously used). 3. Destroying larvae by introducing certain fish like the minnow which feed on the larvae and pupae of mosquitos. 4. Treating patients with the anti-malarial drugs. Prevention and spreading of infection by isolating the patient is important. The patient should be kept under a mosquito net to prevent mosquitos from biting and spreading the infection.

### 1.15. Controlling harmful microorganisms

Several types of fruits and vegetables are preserved for later use. The preservation is meant for protecting the foods against decay from their own metabolism and spoilage or contamination by microorganisms, while retaining the natural flavour, taste and nutrients of the food. The methods used to prevent spoilage include — *bacteriocidal* techniques i.e. killing of microbes and *bacteriostatic* techniques i.e. arresting the growth of microbes.

#### BACTERIOCIDAL METHODS

- **1. Irradiation :** This is the best and the cheapest method of food preservation where foodstuff is exposed to ultraviolet rays, x-rays or gamma rays to kill the microorganisms that cause spoilage. All types of food can be preserved in this way, i.e., grains, fruits, vegetables,

fish, meat, etc. Irradiation kills the microorganisms responsible for spoilage and contamination.

2. *Proper cooking* : Normal methods of cooking involve boiling or frying food at temperatures near  $212^{\circ}\text{F}$  ( $100^{\circ}\text{C}$ ). The endospores of certain bacteria are not killed at this temperature. As soon as the cooked food cools, the endospores germinate and cause spoilage of food. Hence it is better to cook the food in steam in pressure cookers. This raises the temperature to  $275^{\circ} - 350^{\circ}\text{F}$  ( $135^{\circ} - 176^{\circ}\text{C}$ ) for a few minutes and kills the endospores of all bacteria.

3. *Pasteurisation* : Ordinary fresh milk gets spoiled very soon due to contamination from several types of microorganisms. To avoid early spoilage, milk is pasteurised. This involves heating milk for about 15–30 minutes at  $140^{\circ}\text{F}$  ( $60^{\circ}\text{C}$ ) and then suddenly cooling it to  $55^{\circ}\text{F}$  ( $12.5^{\circ}\text{C}$ ). The pasteurised milk is bottled under aseptic conditions.

4. *Canning* : Here foodstuff is preserved, inside airtight or sealed cans. The food may be canned both in the raw state or after boiling. The raw foods are sweetened, salted or dehydrated before canning or the food is cooked in steam under pressure at  $275^{\circ} - 350^{\circ}\text{F}$  and then canned. Sometimes a small quantity of a chemical preservative may be added.

5. *Jams and jellies* : Many types of fruits are preserved in the form of jams and jellies. These are put into hot or boiling syrups of sugar. The heat kills the microbes and also softens the fruits. Small quantities of preservatives like citric acid are added to prevent the growth of microorganisms. They are stored in tightly closed glass jars or canned for marketing.

#### BACTERIOSTATIC METHODS

1. *Dehydration* : You often see vegetables being dried in the sun in many homes. Such sun-dried vegetables may be further preserved by salting, addition of sugars, etc. It is, of course, less hygienic as the drying foodstuff may get infected by houseflies, other insects and birds. A more hygienic method is to dry the foodstuff in an oven before packing it in cellophane bags or airtight containers. Green leafy vegetables should be burnt or scalded with steam before dehydration. The scalded vegetables can then be dehydrated and

immediately canned to avoid *discolourisation*. This method of dehydration after scalding is called *blanching*.

2. *Preservative* : It is common to add vinegar in salads for preserving them. Addition of sugars and salt are other methods to protect the food from microorganisms. *Pickling* uses the same techniques. Sodium propionate is another good preservative.

3. *Antibiotics* : Meat, fish and other perishable food articles have been protected from infection and spoilage by injecting or dusting them with antibiotics (e.g., aureomycin, terramycin, etc).

4. *Refrigeration* (cold storage) ; Low temperature makes the decay causing enzymes present in the food inactive and also prevents microorganisms from multiplying. Milk, fish, meat, etc. should be kept near 32°F (0°C). Bananas and starchy foods should be kept at 50°–54°F (10°–12°C)

5. *Freezing* : It is the best method of preservation of meat, vegetables, fruits, cheese, etc. These are washed, peeled, cooked and wrapped in small cellophane bags and kept under frozen conditions for several days or even months.

*Activity 21: Try to collect paper-cuttings regarding the new methods and techniques of food preservation.*

## 1.16. Prevention of harmful microorganisms

### EDWARD JENNER'S OBSERVATION AND EXPERIMENT

Edward Jenner, an English physician, had seen epidemics of smallpox and observed that dairymen and milkmaids rarely suffered from this disease. He discovered that milkmaids contracted a mild disease called cowpox from the cattle they milked which left a scar on their hands. They seemed to be safe from smallpox.

On May 14, 1796, Edward Jenner took some fluid from a cowpox sore on the hand of a milkmaid and injected it into the arm of a healthy boy named James Phipps. Phipps, developed a similar sore on his arm but this soon healed. After two months, Jenner injected some smallpox fluid into the boy, but he didn't develop smallpox. Jenner was amazed.

He tried out his experiment many more times and found that people infected by the virus became immune to smallpox. Though people

mocked him in the beginning, they soon realised the value of what he had achieved. Jenner had discovered the smallpox vaccine and he vaccinated thousands of people in his lifetime! The grateful British Government honoured Jenner with a gift of 30,000 pounds.

It is wonderful to note that today, several years after Jenner's discovery the world has been declared free of the dreaded disease smallpox!

## VACCINE

A *vaccine* is an extract of tamed or half dead pathogens injected into human beings. This induces the production of *antibodies* which continue to live for a few or several years. Vaccination is given for polio, cholera, typhoid, etc.

A vaccine is prepared by injecting the 'diseased organism' into animals like rabbit, horse, etc. The infected fluid is later taken from the animal and is stored in sterile containers. It is frozen and then heated or mixed with salt, glycerine, etc. to inactivate or kill the pathogen. The fluid now called a vaccine is stored in tubes.

## IMMUNITY

The resistance to contract a disease is called immunity. There are two types of immunity, *natural* and *acquired*.

*Natural immunity*: The natural immunity is the inborn resistance to diseases of other organisms. You may have noticed that some people do not fall ill even if they live among infected persons. This shows that these people were born with the ability to resist a certain disease. Natural immunity usually lasts throughout a person's lifetime.

*Acquired immunity*: Another type of immunity is known as acquired immunity. This kind of immunity may be acquired in two different ways:

1. *Active acquired immunity*: This kind of immunity develops after a person recovers from a disease. During the illness, specific antibodies help the body to destroy germs of that particular disease. For example, recovery from measles usually makes the body immune

to another attack because the body develops specific antibodies to fight the disease.

2. **Passive acquired immunity:** This can be acquired by vaccination or inoculations as a protection against disease. It may not last a lifetime because it involves introduction of a foreign substance which the body tends to get rid of naturally.

## DEFENSIVE MECHANISMS

We have seen how man has used his intelligence to consciously protect himself against diseases. We shall now study some of the natural ways by which the bodies of human beings adapt themselves to do this.

Human beings have three natural ways of protecting themselves from attacks rather like an army defence line.

*The first line of defence :* This is our skin which prevents bacteria from entering our bodies. The microbes may also be prevented, to some extent, from entering our nostrils because of the hair and mucous membranes which line the nostrils. Some microbes get caught in the windpipe. Coughing, sneezing and vomiting help in ejecting foreign bodies. Our stomach also secretes acids which kill bacteria which we may take in along with our food.

An open wound is an opening through which microbes may enter our bodies.

*The second line of defence :* If the microbes somehow get past the first line of defence, the second line gets into action. These are the *white blood cells* in the blood, also known as the body's *police force*. Thousands of these rush to the place of infection, surround the bacteria in an amoeba-like way and destroy them. The infected area becomes hot, red, painful and swollen as it contains numerous bacteria and white blood cells. Sometimes the area of infection become hot and forms a boil or sore. Many of the white blood cells die and form pus.

*Third line of defence :* If the number of bacteria is very large, the white blood cells may not succeed in destroying them. Then the bacteria enters the patient's blood vessels and spreads the poison and he develops fever.

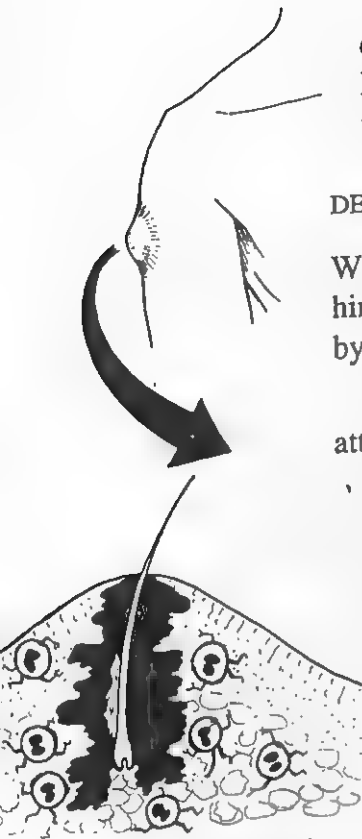


Fig. 1.28 The body's police force

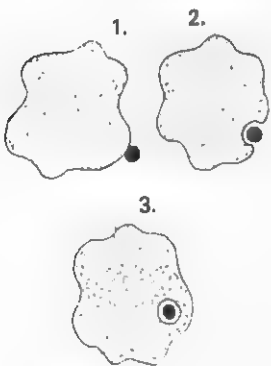


Fig. 1.29 A white blood cell ingests a bacterium

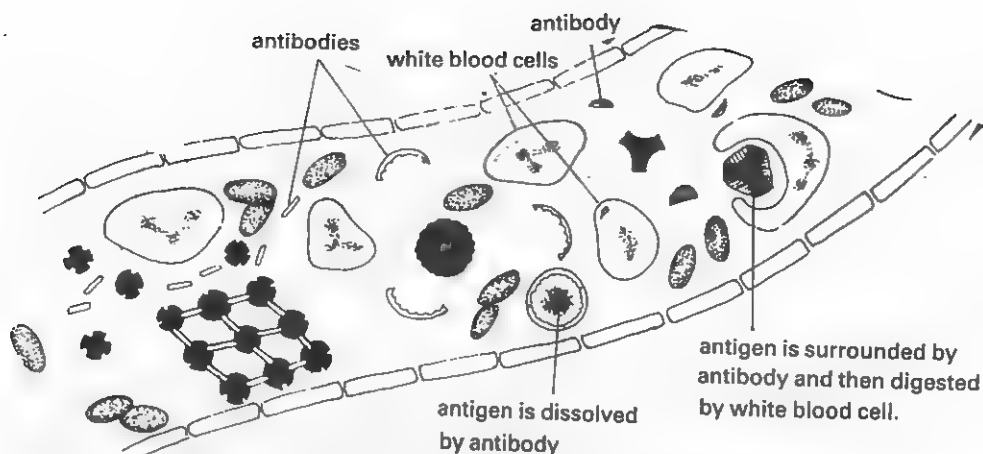


Fig. 1.30 Antibodies and their reactions.

The fight against the microbes continues because our body begins to produce special compounds called *antibodies* to kill or neutralise them. Each type of bacteria requires a different type of antibody to destroy it. Any bacteria or virus entering our body is known as an *antigen*. If the antibodies manage to destroy the antigens the person recovers from the disease.

## ANTISEPTIC

Antiseptics are chemical substances that prevent the multiplication of germs by creating an unfavourable environment. They do not kill germs. Dettol is an antiseptic lotion. Joseph Lister of Great Britain first started using antiseptics. Surgery was made less fearful once antiseptics were employed.

## STERILISATION

Today every hospital article is disinfected periodically. The practice is called *asepsis*. Surgical instruments are now sterilised with the help of pressurised steam for 15-30 minutes in an apparatus called autoclave. The final aim of aseptic treatment is to eliminate germs from the environment altogether. This is specially necessary in modern operating theatres and intensive care units in hospitals.

## PASTEURISATION

Louis Pasteur, the French microbiologist established the 'germ theory' of disease. He showed that microorganisms are not spontaneously

generated from non-living matter but come from pre-existing microbes. He discovered that microorganisms could be destroyed by heat treatment, thus providing the basis for sterilisation and preservation of food. Sterilisation of milk by heat treatment is known as *pasteurisation* after him. The temperature of milk is suddenly raised to 145 - 160° F for a short period, and then suddenly cooled. This kills forms of active bacteria.

**Activity 22 :** *Collect pictures and data about Louis Pasteur, Edward Jenner, Joseph Lister, Ronald Ross. Write an autobiography of each. Present it to your classmates in the form of a mono-act or a dialogue or a skit. Some of you can compose riddles about these scientists.*

**Some basic concepts:**

1. Most living organisms can easily be distinguished from non-living objects.
2. A living organisms has a definite appearance.
3. Cells are the structural and functional units of living organisms.
4. A living organism is a self-maintaining system.
5. The sum total of the numerous and varied chemical reactions that take place in the cells and tissues of living organisms is called metabolism.
6. Organisms must adjust themselves to survive change in the environment (adaptation).
7. Living organisms respond to stimuli (irritability).
8. Living organisms grow and increase in size.
9. Living organisms undergo orderly cyclic changes (i.e. birth, growth, reproduction and death).
10. Animals are divided into two major groups - vertebrates and invertebrates.
11. Protozoans were the first animals to be formed on this earth. Some of them cause diseases like malaria, amoebiasis, sleeping sickness, etc.
12. Insects which carry disease producing germs are known as vectors. E.g., malaria (*Anopheles mosquito*).

13. Malarial parasites live in the human blood and need two hosts to complete their life cycle.
14. Several methods (pasteurisation, dehydration, cold storage, sterilisation, antiseptics, antibodies, radiant energy) have been devised to control the harmful activities of microbes.
15. The human body has a number of defence lines against disease causing organisms.
16. Natural immunity is the inborn resistance to contract a disease. Acquired immunity is of two types - active and passive.

### **Some suggested projects / activities**

1. *Find out how vaccines and serums are prepared. Visit an institute such as King Institute, Guindy, Madras and observe the preparation of vaccines and serum.*
2. *Try to visit a hospital and find out how the surgical instruments are sterilised in an autoclave. Visit an operation theater and find out the use of antiseptics.*
3. *Find out about human protozoan parasites and classify them under the following heads: 1. Name of the parasite. 2. Site of infection 3. Symptoms 4. Vector 5. Control measures / preventive measures.*
4. *Collect pictures of various creatures of land, fresh water and marine water. Try to classify them as vertebrates / invertebrates. Get guidance from your teacher or refer an encyclopedia for this.*
5. *Observe preserved specimens or slides of yeast, paramecium, hydra, earthworm, insect, spider, fish, frog, lizard, etc. Write four lines on each about their morphological features.  
If possible compose biological riddles and display them on your bulletin board with suitable illustrations.*
6. *Conduct a 'word-building' game on vertebrates.*
7. *Prepare a list of vertebrates and invertebrates that you may come across in and around your school and home.*

*I Answer the following questions briefly:*

1. What are the features that are common to living organisms and to non-living objects?
2. What is the basic unit of life?
3. Living things are better called 'living organisms'. Give reasons.
4. Would you consider viruses to be living?
5. How does the growth of a living organism differ from the growth of a crystal?
6. What is the use of locomotion to animals?
7. List the major differences between living organisms and non-living objects.
8. What features will you look for to differentiate between a living organism and a dead one?
9. What are the advantages to an organism in having its body composed of different kinds of cells?
10. What are metazoans? How do they differ from protozoans?
11. List the special features of coelenterates?
12. Distinguish between platyhelminthes and nemathelminthes. Give examples of each.
13. Name the commonest annelid that you have seen.
14. What are the salient features of arthropods? Name a few common members of this group.
15. Try to explain how coelenterates are superior to sponges?
16. Why are sponges classified as 'porifera'?
17. Fishes have bodies adapted for their aquatic habitat. Explain.
18. Mammals are the most evolved of all vertebrates. Explain briefly.
19. How do parasitic microorganisms cause diseases in man?
20. What are the different ways in which disease-producing organisms are transmitted?
21. Explain how the natural defensive mechanisms of the body work against the invading germs?
23. What is immunity? Distinguish between (a) natural and acquired immunity (b) active and passive immunity.
24. Give an account of the life cycle of Plasmodium with suitable illustrations.

*II. Define the following terms.*

1. Anabolism   2. Catabolism   3. Metabolism   4. Adaptation   5. Vaccines
6. Antibiotics   7. Vectors   8. Fomites

**III. Differentiate between the following pairs.**

1. plasmodium and entamoeba. 2. antigen and antibody. 3. antibiotic and antiseptic.
4. epidemic and endemic. 5. vaccination and inoculation. 6. sterilisation and pasteurisation.

**IV. Give scientific reasons for the following:**

1. Drinking water supplies are usually chlorinated.
2. Gross infection is now less common in the surgical wards of hospitals.
3. Milk becomes sour in two to three hours.
4. Cooking food in a pressure cooker helps to preserve the food.

**V. Write short notes on:**

1. vertebrates 2. invertebrates 3. protozoans 4. spreading of microbes (mode of transmission) 5. Edward Jenner and the smallpox vaccination 11. methods of prevention of harmful microbes.

## 2. Organisation of animals

*Organs and organ systems - (organs and functions) in man - muscular, skeletal, circulatory, respiratory, excretory, reproductive systems - locomotion - meaning and need - locomotion in lower animals - locomotion in higher animals - (role of muscles, bones and tendons) - co-ordination - meaning and need - role of nerve cells, receptors, effectors and brain in the control of voluntary and involuntary actions - endocrine glands - hormones.*

You have already learnt that living organisms vary a great deal in form and function. If you study the living world carefully you will realise that the shape or form of an organism is most suited to its way of life and to the environment in which it lives. Similarly, cells, tissues and organs that make up an organism are perfectly adapted to their particular function. In fact, at every level of organisation, structure is closely connected to function.

In multicellular animals various organs are highly specialised to perform one or more functions. Many organs co-ordinate their activities to carry out a common function in an organ system. All the organ systems jointly make up an organism.

### 2.1 Organs and organ systems in man

There are several organs in the human body. The stomach, intestine and heart are examples. Each of these consists of several tissues. Thus the heart consists of muscle tissue, epithelial tissue, connective tissue and

vascular tissue. Though each of these tissues is specialised differently, collectively they form a distinct organ, the function of which is to pump blood and help it circulate in the body.

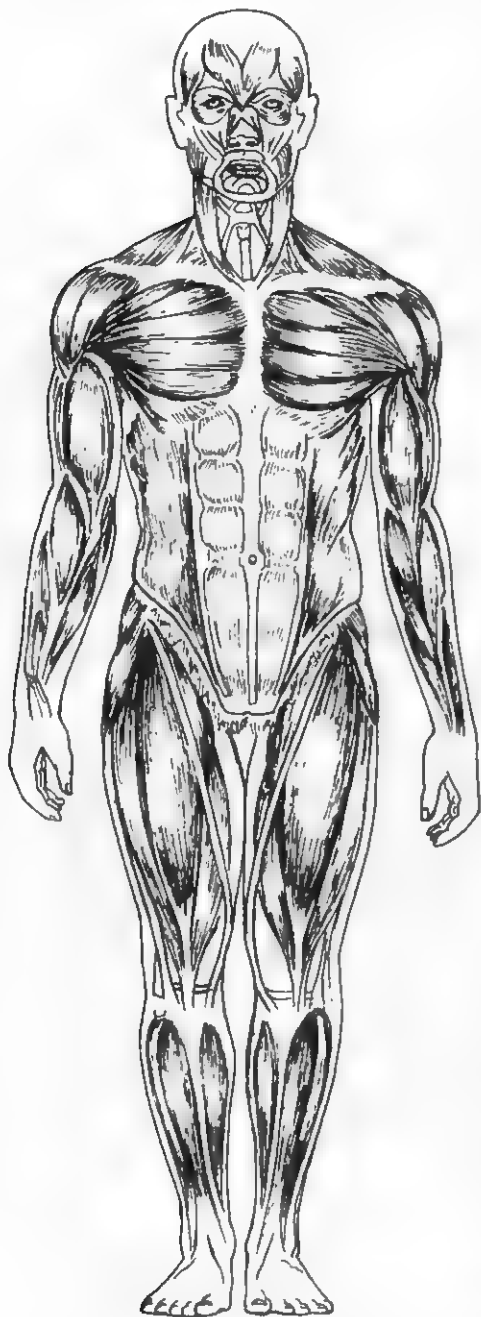


Fig. 2.1 The human muscular system

Most organs, too, do not work by themselves satisfactorily. For example, when food is digested it is mainly absorbed in the small intestines but before this, it is processed and prepared in the mouth and the stomach. Glands like the salivary glands, pancreas, etc, supply the necessary chemicals to break down the food. Thus the process of digestion is carried on by a group of organs called an organ system, performing a common function, e.g., the digestive system. The human body consists of many such organ systems.

### THE MUSCULAR SYSTEM

The muscular system is made up of muscular tissue. There are three different types of muscular tissue, namely, *voluntary*, *involuntary* and *cardiac* muscular tissues. The thigh muscles and calf muscles of the leg, the biceps and triceps of the arm are some of the major muscles of the body. They are attached to the bones of the skeletal system.

The activities of these muscles along with others bring about movements of the body parts and locomotion. The cardiac muscles helps the heart to contract and

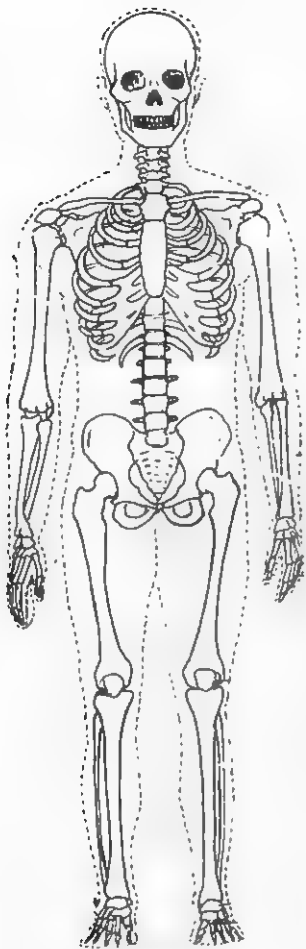


Fig. 2.2 The skeletal system

pump the blood. The smooth muscles cause some of the involuntary movements of the internal organs.

The muscles are never completely relaxed. Some mild contractions are always seen in muscles. This condition is known as muscle tone. Because of this muscle tone, the muscles are able to keep the body's shape and posture.

### THE SKELETAL SYSTEM

This system, consisting of many *bones* and *cartilages*, makes up the main supporting frame work of the body.

In some animals, e.g., snails, crabs, cockroach, etc. the skeleton is outside the body and is called an exoskeleton. In higher animals, like man, the skeleton is within the body and is called an endoskeleton.

The skeletal system supports and gives shape to the body, protects delicate organs and is also attached to the muscles which in turn help in locomotion.

**Activity 1 :** *Examine the skeleton of a human being. You might have one in your Biology laboratory. If not, try to find a picture of it.*

**Activity 2 :** *Examine the exoskeletons of a prawn, a crab, a cockroach and write two lines on each.*

### THE CIRCULATORY SYSTEM:

This is known as the transporting system of the body. It consists of the heart, arteries, veins, capillaries, blood and lymph. The nutritious

materials absorbed from the digestive tract are transported to every cell in the body. The metabolic waste products produced in the cells are collected by the blood and transported for removal from the excretory organs. Oxygen is carried from the lungs to the cells and carbon dioxide from the cells of the body back to the lungs. The blood also acts as a medium of transport for enzymes and hormones.

*Activity 3 : Dissect a frog with the help of your teacher. Observe its heart and blood vessels. Examine the other internal organs and try to identify each one.*

### THE RESPIRATORY SYSTEM

The respiratory system is composed of the respiratory

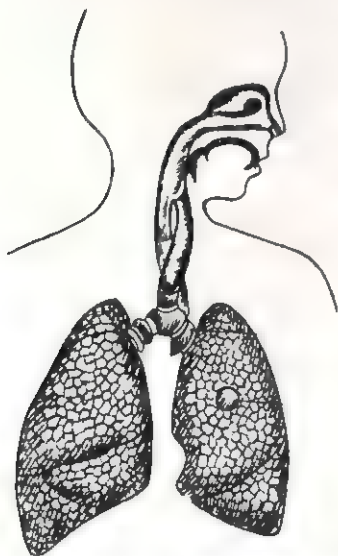


Fig. 2.4 The respiratory system

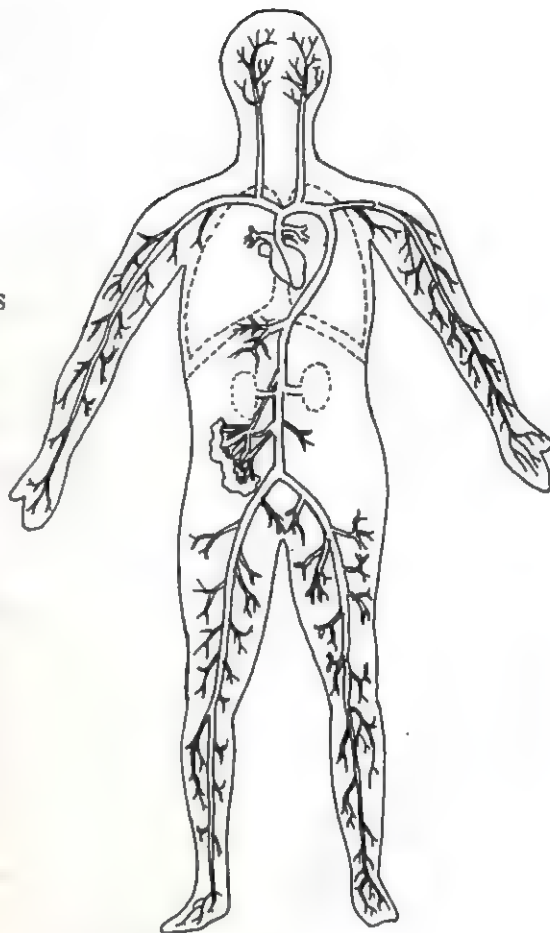


Fig. 2.3 The circulatory system

passage and the respiratory organs. The term 'respiratory passage' includes the external nostrils, buccal cavity, pharynx, larynx, trachea and bronchi. In man, the main respiratory organs are the lungs. In most higher forms the skin, too, plays an important role in respiration.

For cells of the body, respiration is as important as feeding. This is because the energy present in the food is

only released during the process of oxidation. The cells use this energy to do work. It is important to realise that respiration is not merely breathing in and out. It is the process whereby oxygen from the atmosphere is taken in and carbon dioxide is given out.

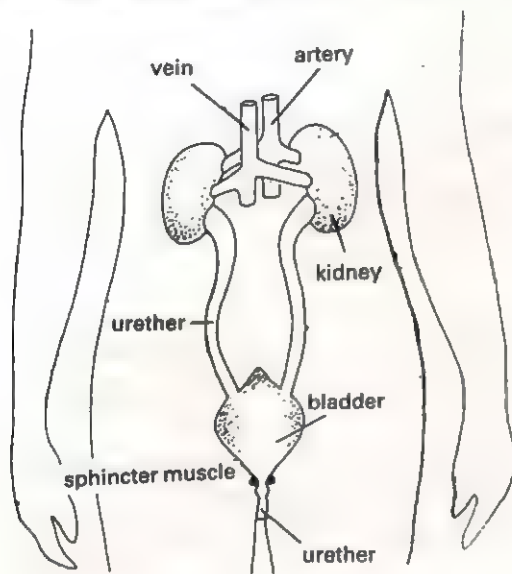


Fig. 2.5 The human excretory system

## THE EXCRETORY SYSTEM

The food supplied by the digestive system and the oxygen supplied by the respiratory system change further within the cells, and start a series of chemical reactions called life activities. At this time, poisonous substances like ammonia and carbon dioxide are produced. The excretory system is in charge of collecting these metabolic wastes from the cells and removing them

from the body. The kidneys have a complicated system of kidney tubules, which extracts the wastes and drains them into the ureter. The urine is discharged by periodic contraction of the urinary bladder.

The skin and the lungs also play a role in the discharge of metabolic wastes from the body.

## THE REPRODUCTIVE SYSTEM

The reproductive system consists of the reproductive organs and the reproductive ducts. The male reproductive organ, the testis produces the *sperms*. The female reproductive organ, the ovary produces the *eggs* or *ova*.

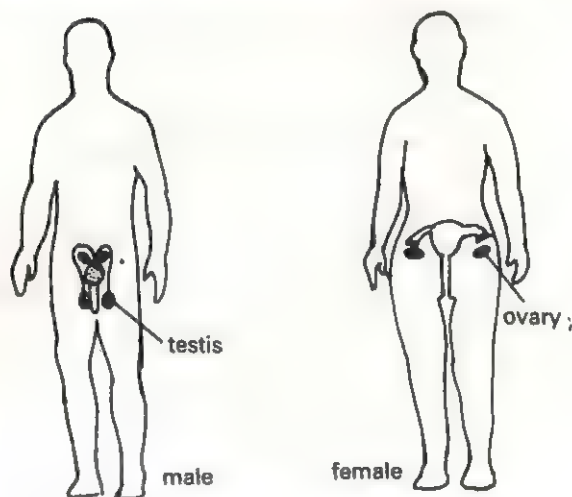


Fig. 2.6 The reproductive system

Based upon the type of reproductive organs present, the individuals are classified as males or females. During reproduction a sperm fuses with the ovum, producing a *zygote* which is the starting point in the development of a new individual.

The integumentary, digestive, nervous and endocrine systems are some of the other systems of the body.

**Activity 4 :** *The human body may be compared to a large institution such as a college, which has many departments. Select any two systems and compose a dialogue to bring out each one's importance.*

Systems	Organs	Functions
1. Skeletal system	bones and cartilage	giving shape, support and protection
2. Muscular system	voluntary, involuntary and cardiac muscles	controlling the movements in the body
3. Circulatory system	heart and blood vessels	transporting, food, oxygen, enzymes, hormones etc. to various parts of the body.
4. Respiratory system	nose, nasal passage, larynx trachea and lungs	taking in oxygen for oxidation and sending out carbon dioxide
5. Excretory system	kidneys, skin and lungs	eliminating waste products (metabolic waste products)
6. Reproductive system	testes or ovaries	creating a new living thing of the same kind.

## 2.2 Locomotion: meaning and need

Locomotion means the action or ability of moving from one place to another without any external help. We see many different animals moving in different ways and at different speeds. These different forms of movement and speed depend on several things. Firstly, it depends on whether the animal is moving in air, on land or water. To move in air they usually have wings. In water, animals may have fins or paddles and streamlined shapes which allow water to flow over the body easily. The land animals, develop legs instead of fins and here we find creatures which crawl, glide, walk, run and jump. Animals need to

move from one place to another for various reasons. The main reasons for their locomotion are as follows:

1. *In search of food:* Some animals have to move very fast in search of food. They may have to stalk, hunt and kill their prey.
2. *Escaping from enemies:* Almost every animal is hunted or attacked by another animal. In order to escape from them they may need to move across a great distance.
3. *Response to stimuli:* Animals respond to various stimuli. They may move towards or away from light, water, poisonous substances in their environment, etc.
4. *Migration:* It is a well-known fact that some species of birds, fishes and even mammals travel great distances, facing many dangers, following some instinct that we still haven't understood clearly. They seem to be looking for warmer places or better living conditions. Most of them return to their original habitat when conditions become suitable again.
5. *Breeding:* Some animals like birds, fish, insects, frogs, snakes, etc. travel short distances each year either to reproduce (lay eggs and hatch them) or to find a spot to hibernate through the winter.
6. *In search of better living conditions:* Sometimes animals have to move because the place where they live may become unsuitable. Famine, drought, poisonous wastes may be some reasons for this.

## 2.3 Locomotion in lower animals

### AMOEBA

The amoeba has no special organs of locomotion. It moves with the help of finger-like, temporary processes, called *pseudopodia*. A pseudopodium means a "false foot". It's been given this name because it is not similar in structure to the feet of other animals. A pseudopodium can be projected from any part of the body surface. Pseudopodia continuously alter their size and shape and while some of

them withdraw, others develop in another place. As a result, the animal slowly changes its position in a very irregular fashion.

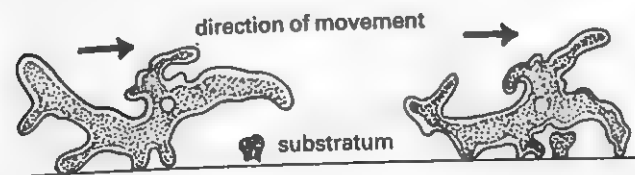


Fig. 2.7 Amoeba showing walking locomotion

This type of locomotion is known as *amoeboid movement*, since it is characteristic of the amoeba. Amoeboid movement is considered to be one of the most primitive types of locomotion in animals.

**Activity 5 :** *Observe some amoebae under a microscope. Pour acetic acid on them. They will quickly withdraw their pseudopodia.*

## EUGLENA

The euglena performs the following two kinds of movement :



Fig. 2.8 Euglena: successive stages of flagellar movement

### 1. Flagellar movement :

The euglena swims fairly fast by active vibrations or lashing movements of its flagellum. The tip of the flagellum proceeds forward through water and its motion drags the body after it.

### 2. Euglenoid movement:

The outer body covering or pellicle is elastic, so that the organism changes its shape frequently. It shows wriggling movements similar to the movement in a vertebrate's

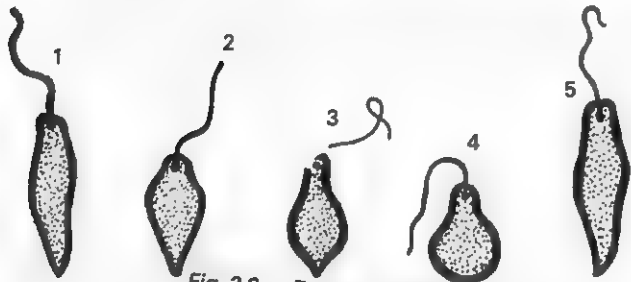


Fig. 2.9 Euglena: Stages of euglenoid movement

intestine. A wave of contraction and expansion passes over the entire body. The body becomes shorter and wider first at the anterior end, then in the middle and later at the

posterior end. This movement helps the cell to move over solid objects.

**Activity 6 :** *Try to observe a paramecium under the microscope and record how it responds to change of temperature and light.*

## PARAMECIUM

The paramecium moves in the following two ways :

1. **Body contortions :** The paramecium can perform contracting and twisting movements and can squeeze through passages which are smaller than its own diameter. These movements are caused by the

contraction of thread-like structures present in its ectoplasm. On leaving the passage, the body soon goes back to its normal shape due to the elasticity of its pellicle.

2. *Ciliary locomotion* : The paramecium has a streamlined body-shape which helps it to go through the water, swimming quite rapidly with the help of its cilia. These are fine, hair-like, processes



Fig. 2.10 The anticlockwise spiral path followed by a swimming paramecium

covering the entire animal. The animal can move in any direction without altering its body form by regulating the beat of about 10,000 to 14,000 cilia. If the ciliary movement is reversed the animal moves

backwards. If the ciliary action is stronger on one side, the animal turns. A swimming paramecium rotates spirally like a rifle bullet more to the left side. It does not follow a straight line.

## EARTHWORM

The earthworm creeps rapidly with the help of its body muscles and setae. It extends and contracts its body during locomotion. This it does with the help of muscle fibres which are arranged in two layers. The circular muscles of the outer layer are arranged parallel to the circumference of the body. The longitudinal muscles of the inner layer are arranged parallel to the length of the body. Contracting the outer layer makes the body thin and long while contracting the inner layer makes the body short and stout.

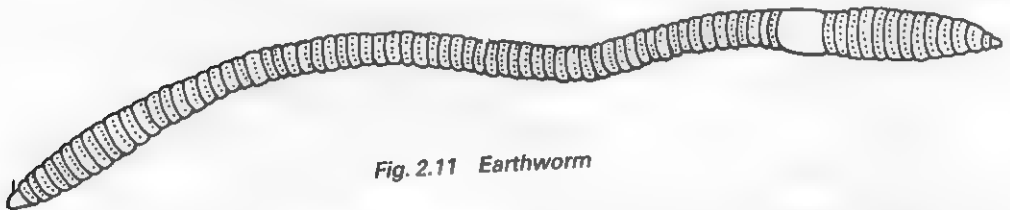


Fig. 2.11 Earthworm

To move forward, the circular muscles in the anterior half contract and the body becomes thin and long. The setae on the segments in front stick out and get fixed to the ground. Next, the longitudinal muscles in the same region contract and the body becomes short and stout and pulls the posterior part forward. Thus locomotion is chiefly brought about by the alternate contraction and relaxation of the muscles of the

body wall with additional help of the setae.

An earthworm can move backwards by reversing the direction of its setae.

It can crawl rapidly over rough surfaces but moves with great difficulty over smooth hard surfaces, like glass, where the setae cannot get a firm grip.

**Activity 7 :** Place few earthworms on a sheet of paper and observe their movements. Keep your ear on the paper. You will hear the noise of its movement. Do you see any legs?

**Activity 8 :** Observe a prepared slide containing the setae of earthworm. Note their shapes and draw diagrams of what you see.

#### INSECT (COCKROACH)

The cockroach has two ways of moving : running and flying.



Fig. 2.12 Leg of a cockroach

**1. Running :** The cockroach runs on the last segment of its jointed legs. In the act of walking or running, the front legs (prolegs) pull the body forward and the hind legs (metalegs) give it a push from behind. At one time, three legs are kept on the ground and the other three are carried forward. The pro and metalegs of one side pull and push the body which is supported on the legs of the opposite side. At this time the other three legs are placed on the ground a little ahead and the first three legs are carried forward. By the repetition of this process, the animal moves forward. The claws work on soft and rough surfaces while the pads work on the hard slippery places.

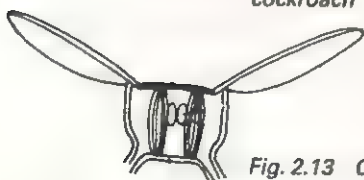


Fig. 2.13 Cockroach: movement of wings in flight



**2. Flying :** A cockroach flies by moving its hindwings with the help of special muscles. The wings are moved up and down alternately.

At each downstroke, the wings push the air downwards and backwards. This propels the body upwards and forwards. During flight, the forewings are held at right angles to the body. Though a cockroach can fly it rarely does so.

**Activity 9 :** Try to observe the forewings, hindwings and legs of a cockroach. Draw diagrams of what you see.

## 2.4 Locomotion in higher animals

In most forms of animals except the very simplest forms the movements of animals are controlled by muscles. These muscles are attached to the joints of the skeleton by means of *tendons* and *ligaments*. The way these muscles are attached to the body, their size and position influences how the animal moves. A slug, for instance has one large foot of muscles and when it contracts or relaxes this, it moves along slowly. In hardskinned animals, like crabs, beetles, etc., the muscles are attached to the hard external skeleton and so it can move the joints and limbs. There are three major ways of locomotion.

### IN WATER

Animals moving in water have stream-lined bodies. Swimming is helped by the flowing movement of water passing down the body and by the contraction of muscles and the tail moving from side to side. Fins help in locomotion and steering. Fishes that have to move fast have long, smooth stream-lined bodies so that the passage through the water is quick, e.g., shark. Fishes that do not need to swim fast are often heavier and fatter, e.g., sole, goldfish.

Besides fishes, certain birds like ducks, pelicans and frogs also spend a lot of time in water. These animals have webbed feet and strongly-developed hind limbs to help them to paddle or swim. Mammals like the whale and seal are streamlined for their fish-like life. Their powerful tails help them to swim.

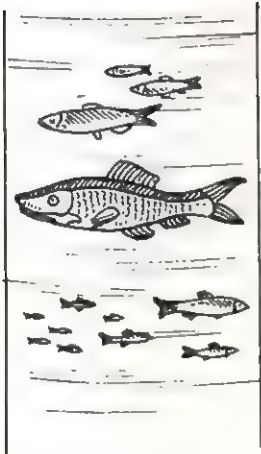


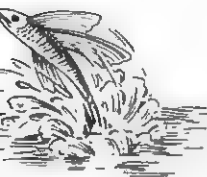
Fig. 2.14 Locomotion in water

### IN AIR

Birds and insects use their wings to glide, ride up and down on air currents or fly actively by beating the air with their wings. The wings of the birds are the adapted front limbs. They are designed to suit the kind of life the bird leads. Some birds can fly as fast as 140 km per hour. Birds use the powerful muscles in their breast to beat their wings. When

a bird wants to land, it must reduce its speed or it will damage itself. To do this, it usually brakes using its wings and tail. Its body is light and its bones are hollow. A bird also has large air sacs in its body to make it lighter in air.

Certain other animals can move through the air – a bat is a mammal that can fly. A flying fish glides forward in the air and the flying squirrel uses the flaps of skin between its legs to parachute from trees.



2.15 A flying fish

## ON LAND

Most animal vertebrates have four legs and move diagonally forward. This means that the right front leg and the left hind leg move forward together, alternating with the left front leg and right hind leg. Even though human beings travel on two legs, we follow this style. For example, as we put our right foot forward, our left arm moves with it.

Although this is the most efficient method of moving on land, not all four-footed animals use this method. Some animals pace or hop along. In pacing, the limbs on one side move together. One example of this is the camel.

The feet of mammals are adapted to the life it leads. The following examples will help you understand this :



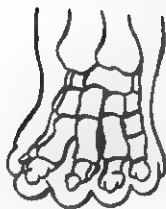
cat foot

**Cat foot :** In mammals where speed is required, ankles are raised up from the group so the creature walks and runs on its toes. It can usually go quite fast, as in the wild cats and dogs.



one-toed hoof

**One-toed hoof :** This is seen in the horse. The raised leg and one toe makes the horse run fast on the hardened plains and grass lands. Its relatives, the zebra and donkey, are similarly built.



elephant foot

**Elephant foot :** The legs are enormous pillars. The toes are united to make a firm base. The greater part of the weight is taken by a pad of elastic tissue at the back of the foot.



kangaroo

**The kangaroo hop :** This Australian animal moves in a series of bounds on its large, strong hind legs. The long thick tail balances the weight of the front of the body as the animal hops quickly along.

Fig. 2.16 Locomotion on land

## ROLE OF MUSCLES, BONES AND TENDONS

Whatever the mode of locomotion higher animals are able to move efficiently because of the proper functioning of three kinds of tissues - muscles, bones and tendons.

The bones form the main supporting framework of their body. If you compare the speed of locomotion in animals which have an endoskeleton with the locomotion in animals without a skeleton you will realise how much faster and more efficient the former is. This is because of its long bones, especially the ones in the legs that act like levers magnifying the movement caused by the contraction of the muscles attached to them.

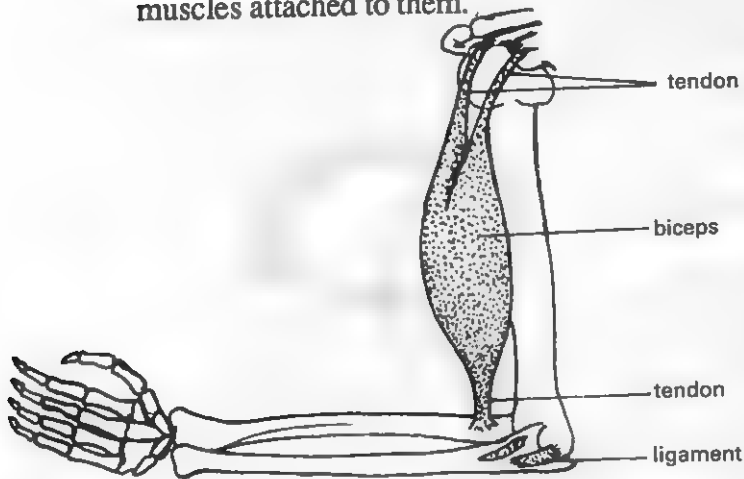


Fig. 2.17 Muscles, tendons and ligaments

Muscle cells are elongated and specialised for contraction and relaxation and are therefore directly responsible for movement and locomotion. Most of the muscles in our body are found connected to the

skeleton by means of thread-like elastic *tendons* and are known as skeletal muscles which are consciously controlled by us.

A joint is a point where two or more bones meet. These bones are held together by strong cords called *ligaments*. All the bones of the skeleton are movably or immovably joined to allow different types of movement or no movement at all. Therefore the joints fall into three categories 1. *immovable joints* – where there is no movement at all. Examples are the bones of the skull and the pelvic bones. 2. *slightly movable joints* – where there is a limited amount of movement. Examples are the bones of the vertebral column. 3. *movable joints* – where the joints can move freely. Here the ligaments help to keep the bones in position according to the kind of movement.

The joints are of different types i.e. *the hinge joint* at the knees and elbow; *the ball and socket joint* in the shoulder and hip, *the pivot joint*

at the neck and the *gliding joint* in the wrist bones.

**Activity 10 :** *Get a joint of a sheep. Try to pull the two bones apart. You will see that the ligaments stretch and return to shape each time the bones are moved.*

**Activity 11 :** *Straighten your arms. Feel the muscles of the upper arm. Now, pull up your forearm. Feel the muscles of your upper arm. It becomes thicker and shorter. Why does this happen?*

**Activity 12 :** *Move your hand and fingers and observe the movement of the bones. Try to identify the muscles and joints which are used. Make a list of the different things you can do with your hand. Try to identify which part of your hand you use to perform a particular function.*

## 2.5 Co-ordination : meaning and need

You have already learnt that all living organisms respond to various stimuli in their environment. These stimuli may be mechanical, chemical, thermal or electrical. For example, if a paramecium or amoeba is touched with a needle, it begins to move in a different direction. Similarly, if a person touches a very hot object with a finger the immediate reaction is to remove the finger from the source of contact. The difference between the two types of responses is that in man and other higher animals this response is



Fig. 2.18 Response to a stimulus

much more complex. What actually happens when a person touches a hot object is that several muscles in the arm contract to close the hand, to flex the arm at the elbow, and to withdraw the whole arm from the shoulder. To do this several messages are sent to the nervous system and the nervous system in turn sorts out these messages and sends other messages back to the various muscles to respond in a particular way.

You can imagine the thousands of messages that go through the various systems every hour and every minute of an organism's life. Indeed, the nervous system is totally responsible for controlling and co-ordinating the working of all the systems of the organism so that it can respond to changes within itself and the environment harmoniously. It collects and sorts out information about the internal state of the human being and its surroundings, evaluates and tells the organisms how to react according to the situation and the person's immediate needs. If an animal cannot co-ordinate its activities properly, for example, if its organs are too slow to react or if his movements are clumsy and jerky it might mean that the nervous system is not functioning as it ought to.

*Activity 13 : Sit or move about by yourself for the next 10 minutes. Make a list of all the stimuli you receive during this period and the responses you make to them.*

*Activity 14 : Work with a partner who is blindfolded. Collect about 10 different objects. Examine it carefully and note down a description of each item. Now ask your partner to feel the objects and describe them one by one. Note the differences and similarities in the descriptions. What other senses did your partner use?*

## **2.6 Role of nerve cells, receptors, effectors and the brain.**

In man and other higher animals the pattern of behaviour, sensitivity and response to stimuli is very well-developed and complex and, therefore, the nervous system which is directly connected to sensitivity and response is also highly developed and complex.

Although the structures of the nervous system have been variously modified to receive, transmit and respond to stimuli, their main function is to bring about the co-ordination of the various activities within an organism, so that the organism acts as an integrated whole.

If you touch something very hot you snatch your hands away, or if

something comes dangerously near your eyes, you close them. This is done 'without thinking' and is called a *reflex action* or an *involuntary action*. In fact, most of our day-to-day activities are the result of reflex actions which take place within a fraction of a second. Reflex action can be defined as a kind of automatic rapid response which seems to happen almost immediately and does not involve the brain. A reflex action is very different from a *voluntary action* when the idea to do something starts in a certain centre in the brain.

*Activity 15 : Work with a partner. Your partner must stare into space. Carefully look at his pupils and observe their size. Now make a loud sound. Write down what happens to the pupils. Next, you can shine a torch into your partner's eyes or gently blow a puff of air into his eyes, or test his reactions in any other way you like. See what happens to his eyes and pupils. Each time note down what you see.*

For a stimuli to produce a response (reflex action) three parts must be involved. These are :

- a. A *receptor* consisting of cells which are sensitive to the stimuli and which actually receive the stimuli.
- b. An *effector* consisting of a gland or a muscle where the action in response to the stimuli takes place.
- c. A *connection* between the receptor and the effector.

The connection is usually the nervous system although the link may also be a chemical one, where hormones are involved.

The nervous system is made up of billions of nerve cells also called neurons. These cells conduct signals from one part of the body to the other. This is done through the wire-like strands which form a part of each neuron. Neurons or nerve cells do different kinds of jobs and according to the functions can be put into two main groups - *sensory neurons* and *motor neurons*.

The sensory neurons are connected with sense organs (like the eyes and ears) and receptors. So the stimuli from the outside are collected by the sense organs and receptors and are then passed along the sensory neurons as nerve impulses. The motor neurons carry the impulses to the muscle. Thus, nerve impulses tell the muscles what to do so that it acts or reacts in a particular way. Thus sensory nerves control all stimuli entering the body whereas motor neurons control all responses made by the body.

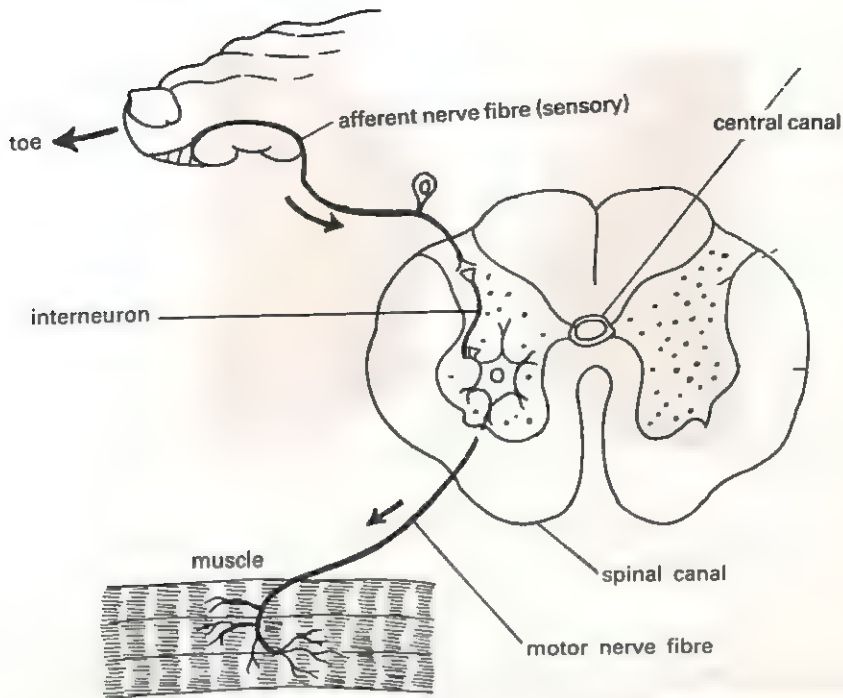


Fig. 2.19 The regions of the spinal cord showing afferent (sensory) and efferent (motor) nerves

The neurons are arranged in a special way in the nervous system. Cell bodies are found mainly along the centre of the body forming what is known as the *central nervous system*. Human beings and other higher animals have a central nervous system which is made up of a *brain* at the head and a *spinal cord* running down the centre of the back. The

motor and sensory nerves make up what is known as the *peripheral nervous system*.

**The brain :** In man the brain is the largest among all animals and is highly developed. It is the centre for intelligence, memory, imagination and reasoning. Different parts of the brain are responsible for the proper functioning of

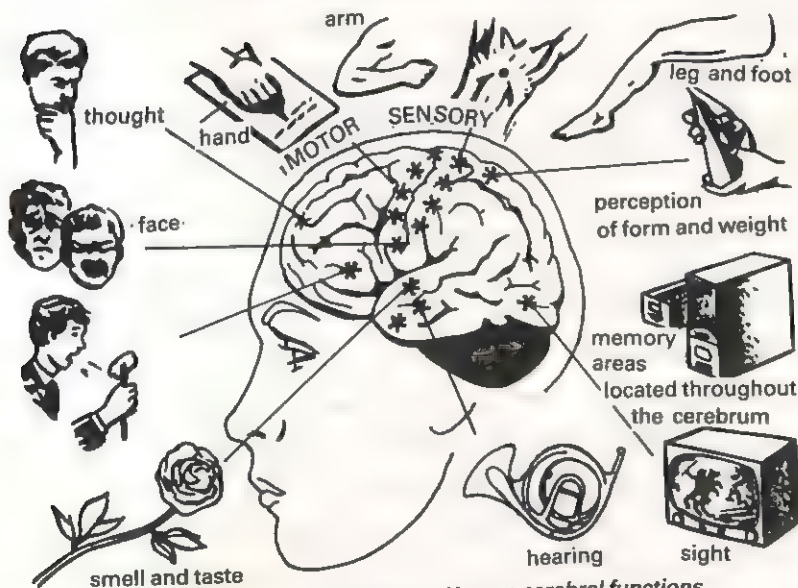


Fig. 2.20 Human cerebral functions

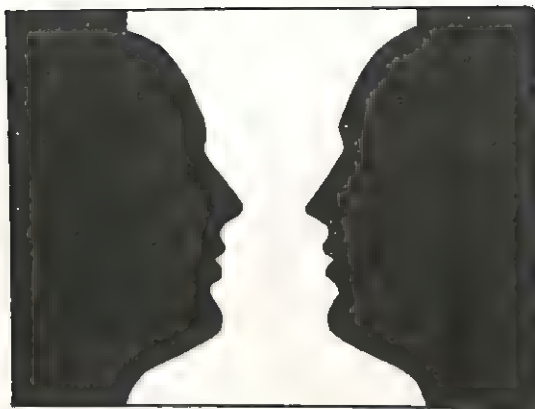


Fig. 2.21 An optical illusion

different parts of the body. For instance, the front upper part receives impulses from different parts of the body; and the back lower part of the brain regulates and co-ordinates the movement of the voluntary muscles as in actions like walking, running, etc. The posterior part of the brain regulates the activities of the involuntary muscles such as the heart beat and respiration.

*Activity 16 : Prepare a list of expressions which connect feelings to different parts of the body. For example, heart-broken, hot-headed, etc. Try to guess how these expressions must have originated.*

*Activity 17 : The picture given here can be perceived in different ways, depending on how your brain interprets the picture. Your eyes see the shape but your brain interprets it in different ways. What do you see?*

**The spinal cord :** This is a long white tubular structure which runs through the vertebral column (backbone). Pairs of nerves are attached along both sides of the spinal cord, these are called *spinal nerves* and contain both sensory and motor fibre.

Thus you see that all the activities of the body are totally controlled by the nervous system, and different parts of the nervous system are concerned with the different types of activities. Reflex actions take place without the help of the brain – only the peripheral nervous system with its receptors, effectors and co-ordinators are connected with this type of action. Other activities originate in the brain. For instance, if

you want to move any part of the body your brain sends an order down the motor nerves and a series of messages are sent to the parts that have to be moved. Actions resulting from these are the voluntary actions. Finally, there are certain movements controlled by another part of the nervous system i.e., the *autonomic nerves* which controls many movements necessary to life – breathing, pumping of the heart, digestion etc.

*Activity 18 : Make a list of about 20 different actions performed by the body. Try to classify them under the following categories - reflex actions, voluntary actions and involuntary actions.*

## 2.7 Endocrine glands – hormones (adrenal, pancreas and pituitary glands)

Most of the body's internal activities are controlled by the secretions of

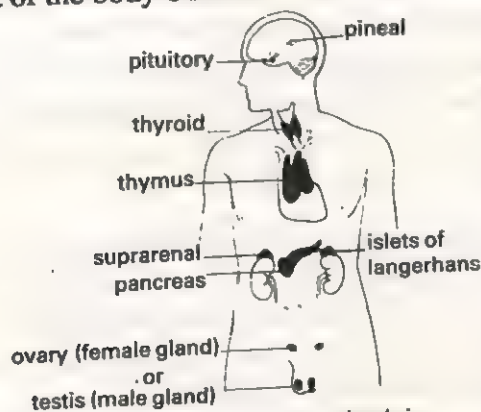


Fig. 2.22 Location of endocrine glands in the human body

certain organs called *ductless* or *endocrine* glands, e.g., *thyroid* and *pituitary*. These glands secrete substances called *hormones* directly into the bloodstream. Hormones are chemical substances which regulate and co-ordinate the activities of cells. They are carried around the body by the

bloodstream and they diffuse into the cells of certain organs.

Chemically, hormones may be simple proteins, amino acids or steroids. Each gland affects the body in a particular way.

Some of the important endocrine glands are:

### ADRENAL GLAND

These are two small structures which lie at the top of each kidney. *Adrenalin* prepares the body for emergency situations of extreme danger, fright or intense physical activity. At times of stress and crisis, it is poured into the blood. The heart begins to pump faster, blood pressure increases, the pupils of the eye dilate, more sugar is released into the blood and the tiny blood capillaries in the skin become narrow.

The result is that more blood goes to the muscles of the limbs so that they can prepare for movement.

Adrenalin is also known as the *emergency hormone*. The response is referred to as fight or flight response.

The adrenal gland also secretes minute quantities of male and female sex hormones. Other hormones regulate the synthesis and breakdown of carbohydrates, fats and proteins.

## PITUITARY GLAND

This is a small, rounded structure about the size of a large pea, found at the base of the brain. It is called the *master gland* because it controls many of the other endocrine glands. The pituitary gland produces hormones which are carried to the thyroid, adrenals, ovaries and testes. These hormones control the amount of hormone each gland produces.

The pituitary gland has other functions as well. When you drink too little, it produces *vasopressin* which acts directly on the kidneys and stops too much water being lost by the body. Vasopressin is not produced when you drink too much liquid. So water can easily be excreted in the urine.

The pituitary gland also produces a growth hormone which stimulates growth of bones and tissues. Some people go on growing till they are over seven feet tall. Others stop growing at three feet. Such extreme cases of *gigantism* or *dwarfism* are caused by too much or too little growth hormone secreted during childhood.

*Oxytocin* is a hormone which acts upon the womb. It causes the contractions of the uterus which give birth to a baby at the end of a pregnancy. It also stimulates the mother's breasts to produce milk.

## PANCREAS

This is located in the abdominal cavity, close to the stomach and duodenum. The tissue which performs the endocrine function consists of many scattered islands of tissues. They are called the *islets of Langerhans*.

These cells secrete the hormones *insulin* and *glucagon*. Insulin helps to lower the blood glucose level while glucagon raises the blood glucose level. The interaction of these two hormones helps to maintain

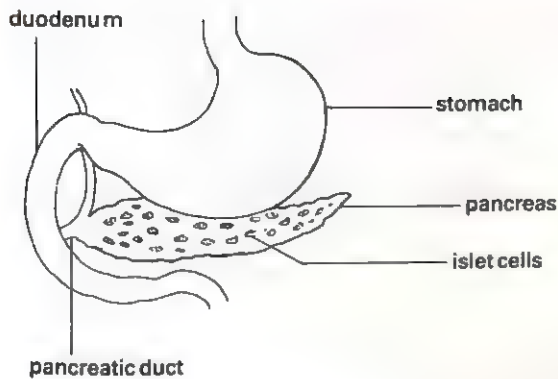


Fig. 2.23 Islets of Langerhans

and balance the blood glucose level.

If insulin is not produced in sufficient quantity, a vast amount of glucose enters the blood and is eliminated in the urine. This disease is called *diabetes mellitus*. Insulin injections are given to such patients to regulate their blood sugar level.

#### Some basic concepts

1. The specialisation of cells does not stop at the tissue level.
2. Different tissues together perform a special function within an organ and a group of related organs performing a common function is called an organ system.
3. Different animals, move in different ways to suit their needs, environment and body structure.
4. Muscles, bones and tendons help higher animals to move.
5. The nervous system is responsible for all main voluntary and involuntary actions.
6. Endocrine organs play a very important role in the regulation and co ordination of body activity.

#### Some suggested projects / activities.

1. Study a paramecium and observe its movement under a microscope. Analyse pond water to observe other protozoans.
2. Observe the movements of different insects in your garden. Write a short note on each.
3. Prepare a poster showing the role of effectors and receptors in voluntary and involuntary actions. Include simple examples.
4. Prepare solutions of 10% table salt (NaCl), sugar solution, vinegar and 0.1% quinine sulphate. Make some cotton-tipped sticks with

*these. Apply each one of these in turns to different places on the tongue. Wash the mouth after every test. Record what taste you get and which part of your tongue experiences a particular taste.*

5. *Visit your local museum. Carefully note the differences in the arrangement and proportions of limb bones in mammals, which move in different ways.*

## *REVISION TIME*

### I. *Match the items in column A and B.*

#### A

1. Integumentary system
2. Skeletal system
3. Muscular system
4. Digestive system
5. Circulatory system
6. Respiratory system
7. Excretory system
8. Nervous system
9. Endocrine system
10. Reproductive system

#### B

- bones and cartilages
- voluntary, involuntary and cardiac muscles
- skin, hair, nails
- nose and nasal passage
- kidneys, skin and lungs
- pituitary, thyroid, etc.
- heart and blood vessels
- mouth, oesophagus, intestine, etc.
- testes and ovaries
- brain, spinal cord, nerves

### II. *Answer the following questions.*

1. What is an organ system?
2. Why are organ systems vital for living organisms?
3. Draw the side view of human brain and label only the major parts.
4. Tabulate the endocrine glands (you have studied) under the following heads.

<i>Location of the gland</i>	<i>Significance of the hormone</i>

5. What are sense organs, impulses and sense receptors?
6. Why do many animals have heads? Is this a better arrangement than having sense organs scattered all over the body?
7. What will happen if
  - a. the pituitary suddenly stops functioning?
  - b. a person is suddenly confronted with a very dreadful situation?
  - c. the front part of the brain is injured?
  - d. the back part of the brain is affected?
  - e. cells in the islets of Langerhans are worn out?
  - f. Why are hormones called chemical messengers? Justify your answer with an example?

III. *Write short notes on*

- i. the muscular system, ii. the respiratory system, iii. locomotion in lower animals, iv. locomotion in higher animals, v. adrenal, vi. pancreas, vii. pituitary.

V. *Use the table given below to classify the following as cell, tissue, organ, organ-system and organism.*

paramecium, tentacle, liver, brain and spinal cord, blood, alimentary canal, hydra, neuron, amoeba.

<i>Cell</i>	<i>Tissue</i>	<i>Organ</i>	<i>Organ system</i>	<i>Organism</i>

V. *Distinguish between*

- a. tendons and ligaments.
- b. triceps and biceps muscles.
- c. voluntary and involuntary muscles.
- d. sensory and motor nerves.
- e. insulin and glucagon.

VI. *Give scientific reasons for the following:*

1. Finger and toe nails are not made of bones.
2. Bones act as levers.
3. The thumb and fingers of man can be used in apposition to each other.

### 3. Nutrition and hygiene

*Food - methods of procuring food - (monkey) - flesh eating animals - mosquito  
- fate of food inside the body - ingestion, digestion, absorption, egestion -  
digestive system in an animal.*

#### 3.1 Food

We know that if we do not eat food regularly we lose weight, become ill and may, in extreme cases, even die. It is obvious that we need food to live. Similarly, we are aware that all living organisms require food to grow, nourish their body and carry on all their life functions.

The method of procuring food, the type of food consumed and the process of digesting it may vary from organism to organism and is, indeed, as varied and diverse as the forms of the organism.

*Activity 1 : Do this activity in groups: One group can conduct a quick survey to find out the favourite food of each person in class. Prepare a large chart to show this. The second group can prepare a chart to find out what is generally eaten by your classmates for breakfast, lunch and dinner.*

You would have noticed from the survey that in your class itself the type of food eaten varies greatly. You can imagine how many different types and varieties of food are being consumed by people all over the world. Different organisms consume different types of food too, depending on various factors like where the organism lives, the types of food, its body needs and the availability of food. Most plants, unlike animals, manufacture their own food during the process of

photosynthesis using simple substances such as carbon-dioxide, water, chlorophyll and sunlight. Animals depend directly or indirectly on plants for food, i.e., they either eat plants or eat animals that consume plants. Some animals like the tapeworm, live as *parasites* on other animals and others live as *saprophytes* on dead decaying matter.

#### THE NEED FOR FOOD

Whatever be the type of food it is essentially a combination of organic and inorganic substance. Food taken in by an organism has four important functions:

1. It provides energy to the organism to carry out all its life functions. This energy is released when the food is broken down into simpler substances during respiration.
2. The food we eat builds up the muscles, bones, cartilage and blood that our bodies are made up of.
3. Food is required for growth of the body. Certain parts of the body continue to grow and produce new cells. Growth is always due to the formation of more protoplasm. The food we take in gets transferred to make the protoplasm and this causes growth. Similarly, repair of old and worn out tissues requires the synthesis of new protoplasm.
4. Consuming the right type of food also helps to build up the body to fight the attack of foreign disease-producing organisms.

### 3.2 Methods of procuring food

There are various ways animals use to obtain their food. The mode of feeding depends on the nature of the food which may be in the form of liquid, small or large particles, an entire organism or a part of it.

Liquid feeders use different methods to take in food. Some of these are:

*Pinocytosis*: This is the process of taking in droplets of dissolved food into the cell. A depression forms in the cell wall which gradually surrounds the prey. This is then pinched off at the tip and the food vacuole migrates to the interior of the cell (e.g., feeding in amoeba).

*Suction*: Mosquitoes and other insects use their mouth parts to pierce plants to suck the juices, or animals to suck the blood. Leeches

cut the body surface of vertebrates to suck blood.

**Tentacular feeding :** Coelenterates usually grab other organisms by their tentacles and transfer them to their mouths. The mouth is surrounded by tentacles, each of which has several stinging cells. These sting and paralyse the prey before it is pushed into the mouth. Most fishes, amphibians, reptiles and birds get hold of their food using their tongues, jaws or beaks. The food is ingested without chewing. Special structures for procuring, masticating, rasping, grazing, etc, are found in other animals. Cuttle fish and octopuses (molluscs) use their arms with suckers. Some arthropods use cephalic (head region) or thoracic (chest) appendages. Some birds have claws to catch hold of their prey.

**Activity 2 :** Choose two vertebrates and two invertebrates. Observe their modes of procuring food. Talk to your classmates about your observations.



Fig. 3.1 Gibbon

**Monkeys :** Hylobates (gibbon) is a small ape. Its arms are long and muscular. These are used for swinging in the branches of trees as well as for procuring food. The arms touch the ground when it is standing. Its feet are used for holding objects.

It is mainly frugivorous (fruit-eating) and arboreal and lives in hilly forests. The gorilla is arboreal in habit and feeds mainly on local vegetation. It is very strong and fights fiercely with its hands and teeth.



Fig. 3.2 Gorilla

Monkeys use their fore and hind limbs efficiently to procure their prey. Their teeth as well as jaw bones and muscles are specially developed for efficient mastication. They are characterised by the presence of *heterodont* (different types of teeth) dentition.

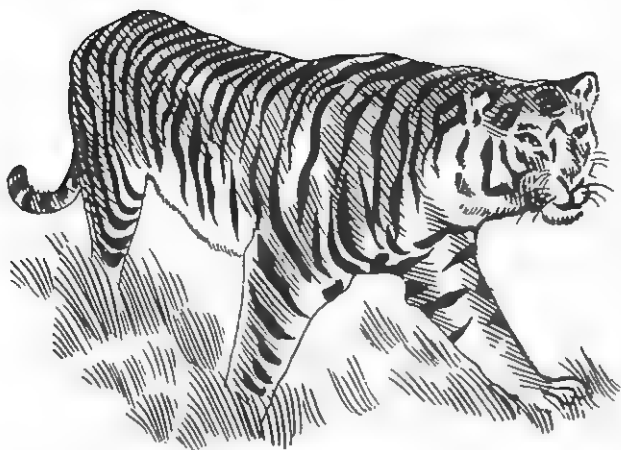


Fig. 3.3 Tiger

*Flesh eating animals (carnivores) :* *Panthera leo* (lion), *Panthera tigris* (tiger), *Felis domestica* (cat), *Panther pardus* (leopard), etc., are terrestrial and nocturnal (night time) hunters with large eyes. They have well-developed *teeth*. The teeth are high crowned and meant for tearing the prey.

Carnivorous dentition is best seen in cats where molars, which are usually found in herbivorous forms, are altogether absent. In dogs, the canines are strong, sharp and projecting.

In piscivorous forms (fish-eating) the teeth are always simple. In certain cases such as whales, the teeth are entirely absent and they possess a strange mechanism for straining out minute crustaceans and

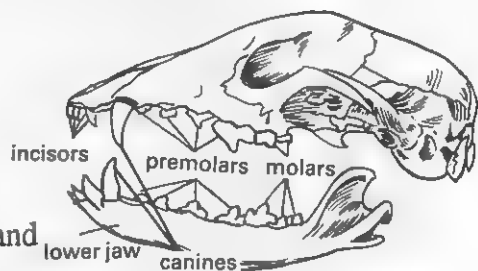


Fig. 3.4 The skull and lower jaw of a carnivore



Fig. 3.5 Walrus

molluscs on which they feed. The upper canines in the walrus form long downwardly directed tusks in both sexes. The tusks are used for digging up food and for locomotion on land. Forelimbs form paddles which are the primary

swimming organs. The hindlimbs can be turned forwards for locomotion on land and for swimming. They are aquatic carnivores which feed on fish, crustaceans and mostly molluscs.

**Activity 3 :** Write a short essay giving suitable illustrations on different kinds of dentition in animals.

**THE METHOD THE MOSQUITO USES TO PROCURE FOOD :**

The mouth parts of the mosquito are adapted to the way in which it procures food. They are used for piercing animal tissue and sucking blood from it.

The mosquito has six, long, pointed sword-like structures called *stylets* for piercing the skin of the host. They are collectively called *proboscis* and each is modified in a certain way. The mouth parts consist of a *labrum*, a pair of needle-like *maxillae*, a pair of needle-like *mandibles* and a *hypopharynx*. The labrum has a groove on the lower side. The hypopharynx encloses a salivary duct. These two when joined

together form a *food channel* for drawing up fluids. The mandibles and maxillae keep the puncture open while the mosquito feeds. The *labium* acts as a sheath for the stylets when they are at rest.

When the mosquito bites a man for instance, all the six stylets pierce the skin. The *labium* is looped in order to let the stylets pierce deeper. Saliva pours through the salivary duct of the mosquito. It contains *anticoagulin* which prevents clotting of blood and also dilutes the blood so that it can pass easily through the food channel.

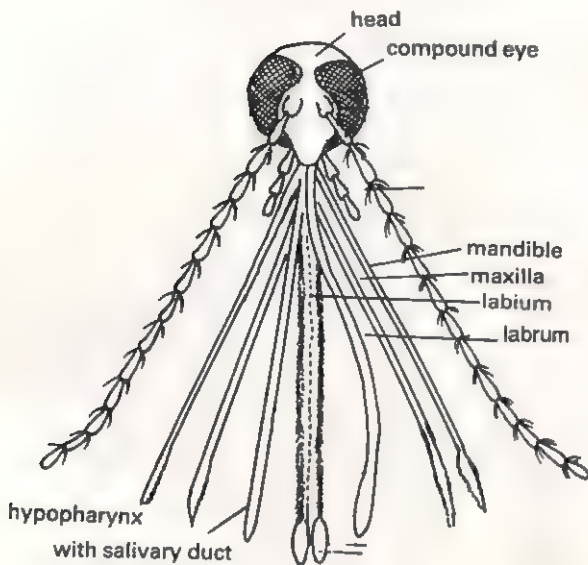


Fig. 3.6 Mouth parts of a mosquito

**Activity 4 :** Examine a prepared slide showing the mouth parts of the mosquito.

### 3.3. Fate of food inside the body

The food consumed by animals generally needs to be digested, i.e., changed into simple substances which can be absorbed by the body. Although the process varies in different animals, what happens is a mechanical and chemical breakdown of food. The food chewed by mammals is broken into small bits and is then acted upon by the *enzymes* produced by various organs of the digestive system. Enzymes are proteins which act as catalysts. They speed up the rate of reaction without undergoing any change.

### 3.4. Digestive system in an animal – rabbit

The rabbit is a herbivorous mammal. It eats shoots, vegetables, leaves and grass. These substances supply the animal with large amounts of water, carbohydrates and mineral salts and some proteins, fats and vitamins.

In a mammal, the process of nutrition begins with the taking in of food or *ingestion*. Then the food has to be broken down into simple soluble and absorbable substances. This process is known as *digestion*. Digestion is followed by *absorption*. The absorbed food is assimilated (made part of) into the different cells and tissues. *Egestion* is the process in which undigested food material is expelled. Except for assimilation, all the other processes occur within a special tube-like structure inside the body known as the *alimentary canal*. The alimentary canal has two openings, one at the anterior end and the other at the posterior end of the body. The alimentary canal and all its associated glands make up the digestive system of an animal.

#### THE ALIMENTARY CANAL OF RABBIT

The alimentary canal of rabbit begins with the *mouth*, which is bounded by a pair of movable *lips*. The slit in the upper lip exposes the incisors

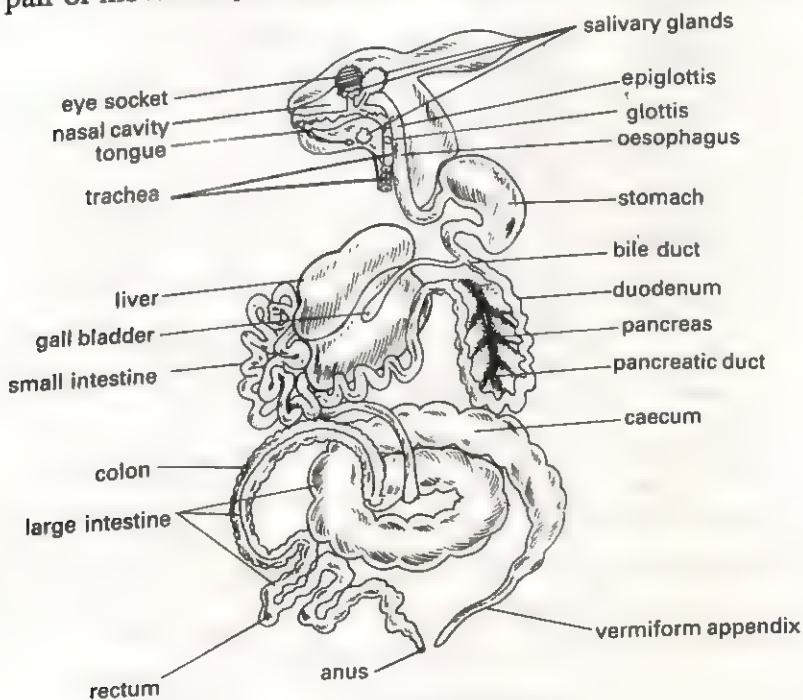


Fig. 3.7 Alimentary canal of a rabbit

in front and helps in gnawing. During the process of ingestion the incisors nibble off bits of food while the back teeth grind this food up into smaller pieces.

The mouth, leads to the *buccal cavity* which contains a long, muscular *tongue* attached behind. It is an organ of taste and helps in the *mastication* of food by rolling the food to the back teeth. The tongue also rolls the food into a ball or *bolus*, and sends it down to the gullet or oesophagus. While the food is being chewed, it receives a watery alkaline substance known as *saliva* from four pairs of *salivary glands* which lead into the mouth by a number of ducts.

The saliva mixes with the food, to make it soft and easier to swallow. Saliva contains an enzyme *ptyalin* which acts on starches, breaking them down into sugar.

**Activity 5 :** Take a piece of boiled potato and continue to chew it for few minutes. You will find that it begins to taste sweet. This happens because the starch has been converted to sugar by the action of *ptyalin* present in the saliva.

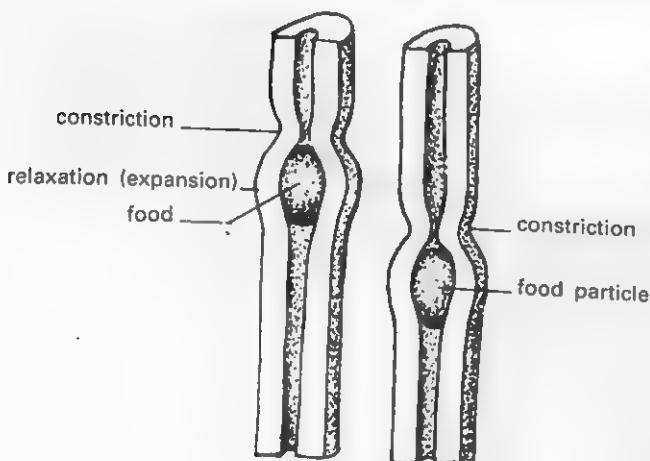


Fig. 3.8 The peristaltic movement of food

occurs in all the regions of the alimentary canal except the stomach.

The stomach is a large pear-shaped organ. Its walls secrete *gastric juice* which contains two important enzymes, *pepsin* and *rennin*, in a dilute solution of hydrochloric acid. The hydrochloric acid makes the medium acidic and kills bacteria. Pepsin acts on proteins and converts them into *peptones*. Rennin causes the coagulation of milk into curds. The gastric juice also contains other enzymes. The food is retained in the stomach for three to four hours. Partial digestion and mechanical

The buccal cavity opens into a wide muscular *pharynx*. The pharynx leads into the *gullet* or *oesophagus*. In the rabbit, the gullet is a narrow tube about 7.5 cm long. It passes through the diaphragm and leads into the abdomen. Its inner wall is lined by a mucous membrane which helps the food to pass easily. The muscles of the oesophagus contract and relax alternately to push each bolus of food downwards by degrees. This process is known as *peristalsis*. Peristalsis

churning of the food reduces it to the thick fluid known as *chyme*. The stomach opens into the first part of the small intestine called the *duodenum*. The food in this region receives two digestive juices, *bile* from the *liver* and *pancreatic juice* from the pancreas. The bile contains a high percentage of water and dilutes the chyme. It contains alkaline salts which neutralizes the acidic nature of the chyme. Finally bile breaks down the fat and splits it into fine droplets.

**Activity 6 :** Take 10 ml. of tap water in a test tube. Add 1 ml. of coconut oil to it. The oil floats on the surface. Cork the test tube and shake it thoroughly. The oil droplets will not be visible anymore, because the large drop of oil has been broken down into many droplets. This is an example of mechanical emulsification.

The pancreatic juice contains three major enzymes namely *amyllopsin*, which acts on carbohydrates and causes their breakdown to simple sugars. The second enzyme *steapsin*, acts on fats and converts them to fatty acids and glycerol. The third enzyme *trypsinogen* which begins to act only in the small intestine in the presence of another enzyme called *enterokinase*. Activated trypsinogen is known as *trypsin*. It causes the breakdown of proteins and peptones to simple substances called *polypeptides*. All the pancreatic enzymes need an alkaline medium to work in

During its passage through the duodenum, the chyme becomes

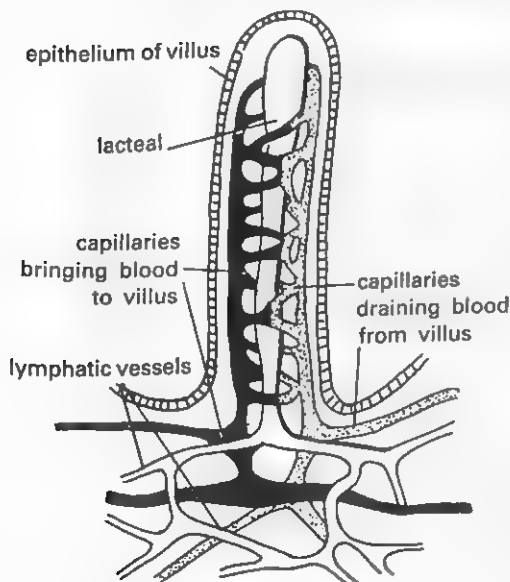


Fig. 3.9 Longitudinal section of a villus

watery and is known as *chyle*. The chyle is sent into the next part of the small intestine, the *ileum*. Certain cells in the wall of the small intestine produce an alkaline liquid called *intestinal juice*. This liquid contains a number of enzymes which work in an alkaline medium. These bring about the conversion of many complex sugars to *glucose* which is the final product of carbohydrate digestion. Another enzyme, *erepsin* causes the reduction of peptones and polypeptides to *amino acids*, which are the final products of protein digestion.

The digested food is absorbed in the

small intestine. The area of the inner wall of the small intestine is covered with many, minute finger-like projections called *villi* which absorb the digested food. They possess *blood capillaries* and a large lymph vessel called the *lacteal* vessel. Simple sugars and amino acids are absorbed by blood capillaries while fatty acids and glycerol are absorbed by the lacteal.

The small intestine passes into the large thin-walled, sacculated tube, the *caecum*. One end is a blind tube leading into a finger-like structure called the *vermiform appendix*. All the remaining undigested food passes down from the small intestine into the caecum. The *large intestine*, is a long tube connecting this region to the *anus*. The first part of the large intestine is the *colon*, the second part is the *rectum*. The faeces is broken into small parts in the rectum and ejected through the anus. This process is known as egestion. A ring muscle control the opening and closing of the anus.

**Activity 7 :** Take equal quantities of white of a boiled egg in two test tubes and label them A and B. Extract the juice from the leaves of papaya. Add one half of the juice to tube A and stir it well. Boil the other half of the juice for 20-30 seconds. Cool the mixture add it to tube B and mix the contents. Note the effect after a few hours and compare the results.

#### Some basic concepts

1. Food is essential for the proper growth and development of the body.
2. On the basis of function, food can be classified as energy giving food, body building food and protective food.
3. Nutrition is the sum total of the processes by the living organisms and repair of wornout tissues. It includes ingestion, digestion, absorption, assimilation and egestion.

#### Some suggested projects / activities.

1. Collect pictures concerning nutritional disorders such as *kwashiorkor*, *rickets*, *osteomalacia*, etc.
2. Visit your school museum or laboratory. Observe the dentition of a *carnivore*, a *herbivore* and an *omnivore*.

3. *Prepare a poster showing the role of enzymes on proteins and fats.*
4. *Take a glass of water. Dissolve some sugar in it. What happens to the sugar? Now repeat the experiment with starch powder (you can use rice flour). What happens?*
5. *Prepare artificial gastric juice by mixing one part of Beneger's liquor pepticus (should be available in your biology laboratory) and ten parts of 0.4% hydrochloric acid. Carry out the following test. Take the white of a full boiled egg. Cut it into pieces and put the pieces in a test tube. Add artificial gastric juice. Heat the above test tube in a waterbath (about half an hour at 37° C). What do you notice? What nutrient is present in the white of an egg?*
6. *To find out the action of rennin on milk, take a pinch of Beneger's rennet along with some calcium chloride. Add boiled milk to the above solution and heat it in a water bath for about 20 – 30 minutes (at about 43° C). Note down your observation.*
- 7.a. *Take Liquor pancreaticus (artificial pancreatic juice) and add this to 1% starch solution in a test tube. Heat it in a water bath. Then add iodine. Note the reaction.*  
*b. Take a few drops of coconut oil. Add a little artificial pancreatic juice. Note the changes that take place.*

## REVISION TIME

### I. Answer the following questions :

1. Explain the process of digestion in your own words.
2. Explain how the salivary glands, pancreas and liver play a part in the process of digestion.
3. What are the functions of food in the body?
4. Why does the body need water?
5. Briefly describe the digestive system of rabbit with the help of a diagram.
6. Briefly describe digestion in the stomach, indicating the chemical changes undergone by various classes of food during this process.
- 7.a. Explain the process of absorption of digested food?
- b. What happens to the following materials after they have been digested?  
 1. proteins. 2. fats. 3. carbohydrates.

8. Explain the meaning of emulsification, peristalsis, acidity.

II. Write one word (or words) in the space provided to complete the second pair of related things.

Example: smelling : nose; sight : eye;

- a. mouth : saliva; stomach :
- b. bile : liver; pancreatic juice :
- c. proteins : amino acids; carbohydrates :
- d. saliva : alkaline; gastric juice :
- e. small intestine : duodenum; large intestine :

III. Write short notes on :

1. the salivary glands    2. pancreas and liver,    3. villus (or) absorption.    4. gastric juice.

IV. Complete the table given below.

Region	Enzyme	Medium of action	Substances acted upon	End product
mouth			starch	
stomach (gastric gland)	pepsin		protein	
pancreas (pancreatic juice)	1.  2.  3.	alkaline	1.  2.  3.	
liver (bile)			fats	
small intestine				

V. Differentiate between

ingestion and egestion.  
absorption and assimilation.  
salivary glands and gastric gland.  
chyme and chyle.

## 4. Reproduction, inheritance and evolution

*Origin of life - abiogenesis and biogenesis - non-living to living elements - condition of prebiotic earth - compound formation of substances - cell formation - more complex forms of life (organic evolution) - extinct forms of life - remains of the past life.*

### 4.1. Reproduction, inheritance and evolution

#### REPRODUCTION : MEANING AND NEED

You have learnt in Chapter I that all living organisms reproduce, that is, they are capable of producing new individuals similar to themselves. The word 'reproduction' means 'making more of the same'.

Reproduction is a process that ensures that the life of a particular specimen continues from one generation to another. This is essential because all living beings on earth live only for a limited period of time (varying according to the organism) and within this period, if they do not produce new individuals of their own kind their numbers will slowly lessen and eventually the species would be completely wiped out from the surface of the earth. To prevent this from happening, nature gives all living organisms the means and the instinct to reproduce. This has been the story of life from its very beginning.

Another factor to be kept in mind is that every living organism competes with other living organisms for its food, oxygen, space, etc.

In this struggle for existence only the fittest individuals survive and therefore the battle has been termed by scientists as the *survival of the fittest*. If there are not enough individuals of a particular species to take up the battle against various types of enemies the species itself would soon be defeated and destroyed. This can be compared to a small band of poorly equipped soldiers fighting against an infantry regiment armed with cannons and guns. Obviously, the fight can only be won if the species increases its numbers and equips itself better!

There are two basic patterns of reproduction among all living organisms – asexual and sexual. In organisms which reproduce asexually, a part or the whole body of the organism divides and separates out. It soon develops into an adult organism resembling its parent. Most of the lower animals reproduce asexually while, in some, both asexual and sexual reproduction takes place. Most higher organisms reproduce sexually. Here the organism produce male and female sex cells or *gametes* which have to fuse together for a new individual to be formed.

## HEREDITY

The gametes are the link between one generation and the next, and they pass on the paternal and maternal traits to the offspring. This relation that continues to exist between successive generations is known as *heredity*.

What an organism becomes is totally dependent upon the interaction between its heredity and the environment. What an organism may become is determined by heredity but what it actually becomes depends on both heredity and environment.

## VARIATION

We know that no two organisms of the same species are exactly alike. Offsprings resemble their parents, but at the same time, they differ from them too. These differences that occur between the members of the same species are known as *variations*.

*Activity 1 : Make a family tree for yourself. See how many previous generations you can trace.*

## 4.1. Origin of life

One of the things that has puzzled and fascinated man for ages and indeed has still not been fully explained is the *origin of life* on earth, i.e., how and why did life begin on earth? Several theories have been put forward by scientists through the ages, some of which have been disproved today. The main theories put forward are :

### SPECIAL CREATION THEORY

According to almost all religious scriptures, all forms of life were created by God. The Bible states that God created the world and all the creatures on it in six days. According to Hindu mythology all living forms have come from Brahma – human beings are supposed to have been created from his head, plants from his body, etc.

This theory has been rejected by scientists.

### THE COSMOZOIC THEORY

This explains the presence of life on earth by assuming it was brought here from some other planet in the universe. Perhaps, it could have started from a falling meteorite.

### SPONTANEOUS GENERATION THEORY

According to this theory, living beings have been formed spontaneously from rain, mud, air, dung, etc. Van Helmont (1577-1644) put forward the theory that mice could be spontaneously produced from a few grains of wheat and human sweat (present on a dirty shirt left in a dark room). This theory appeared to have some truth in it because worms, flies, maggots and other organisms, occur regularly in food and other organic matter without any explanation. At that time people were unaware of how easily eggs and spores could be transferred from one place to another

### BIOGENESIS : LIFE COMES FROM PRE-EXISTING LIFE

The theory of spontaneous generation was seriously attacked by many scientists and finally proved totally wrong by an Italian scientist Francesco Redi in 1668. He took the flesh of four kinds of animals and cooked it so that nothing could have remained alive in it. Then he

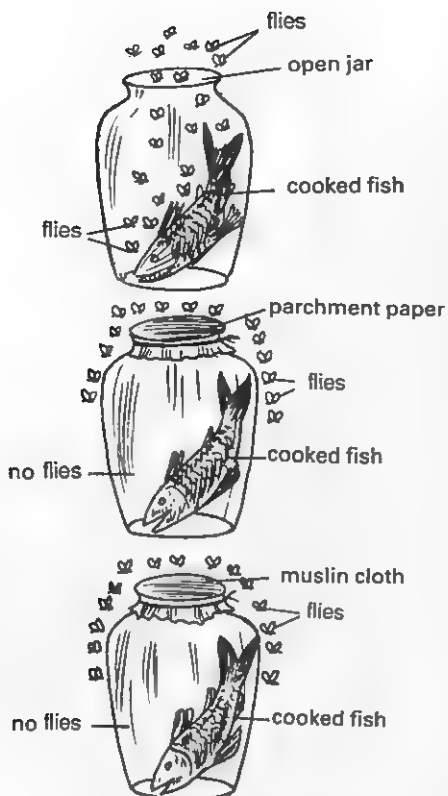


Fig. 4.1 Redi's experiment: (life comes from life)

Darwin's theory of organic evolution also stated that present species had evolved from pre-existing ones, which in turn had evolved from still earlier species.

#### MODERN THEORY OF ABIOGENESIS

All the theories put forward about the origin of life were rejected one by one and scientists were left without any answer. In 1924, a Russian biochemist Alexander Oparin put forward a new theory which was startling. He suggested that organisms have evolved from inorganic chemicals present on ancient earth by a process called *abiogenesis* (a new name for

placed some of each type in three jars. He left one uncovered, the second he covered with parchment and the third with fine muslin. In a few days, maggots (larvae of flies) appeared in the first jar but nothing appeared in the second and third jars. Redi proved that flies laid their eggs on the muslin but it was only when the eggs fell on the meat that maggots began to develop. From this he proved that maggots or larvae do not arise spontaneously but only from eggs laid by parent flies.

Another Italian scientist Lazzaro Spallanzani (1765) conducted many experiments and proved that air contained many microorganisms which germinate on falling on a suitable medium.

Louis Pasteur, a French biologist proved in 1864 that microorganisms do not originate from non-living things and life develops only from pre-existing life. This theory about the origin of life is known as *biogenesis*.

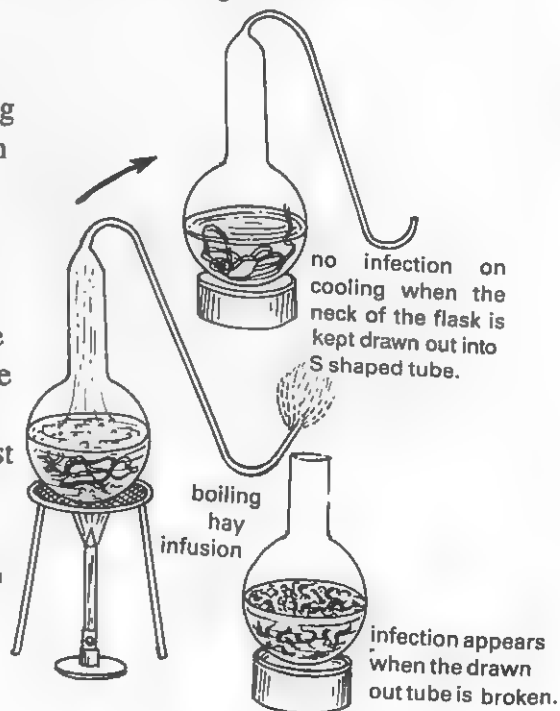


Fig. 4.2 Pasteur's experiment

spontaneous generation). He put forward the theory that life on earth must have started by a series of chemical reactions which changed inorganic compounds into organic compounds. Oparin suggested that the conditions prevalent in the primitive earth allowed such a change to happen.

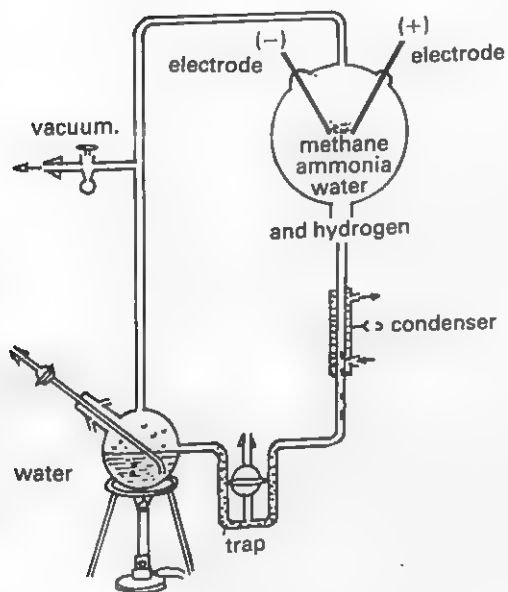


Fig. 4.3 Stanley Miller's experiment

*Stanley Miller's experiment* : Oparin's theory of abiogenesis was ignored for several years till in 1952 an American chemist, Stanley Miller, tried to recreate the atmosphere of the early earth in the laboratory. He placed a mixture of water, ammonia, hydrogen and methane in a special flask and passed an electric spark through the mixture for a week. The electric spark was intended to be similar to the lightning that the early earth was subjected to. He then, analysed the water that had gathered in the apparatus and found that it contained amino acids, fatty acids and sugars. This was an exciting discovery for amino acids particularly are the 'building blocks' of living things.

Scientists today believe that life originated on earth because of a series of biochemical reactions which took place on primitive earth. About 4,500 million years ago, the earth was a place of molten rocks, great electrical storms and

ultra-violet radiation. The atmosphere of the earth contained methane, hydrogen and ammonia. Many chemical reactions took place in this environment giving rise to several large yet simple molecules. Complex molecules evolved from these simple molecules eventually leading to the formation of the first living cells.

After many thousand million years of evolution, the environment today shows an amazing diversity of living organisms which continues to fascinate scientists.

#### 4.2. Non-living elements, condition of prebiotic earth, compound formation of substance, cell formation.

It is today generally accepted that life on earth began to exist about two billion years ago. Before that, for several billion years the climatic conditions on its surface made it impossible for any life, as we know it now, to exist.

We have gathered a lot of information about the history of early earth by studying rocks and fossils. It has been found that rocks are arranged in layers and, generally the deepest layers are the oldest and the uppermost layers are the youngest. Studying these rocks in detail has unfolded to us a great deal about the fascinating history of our earth.

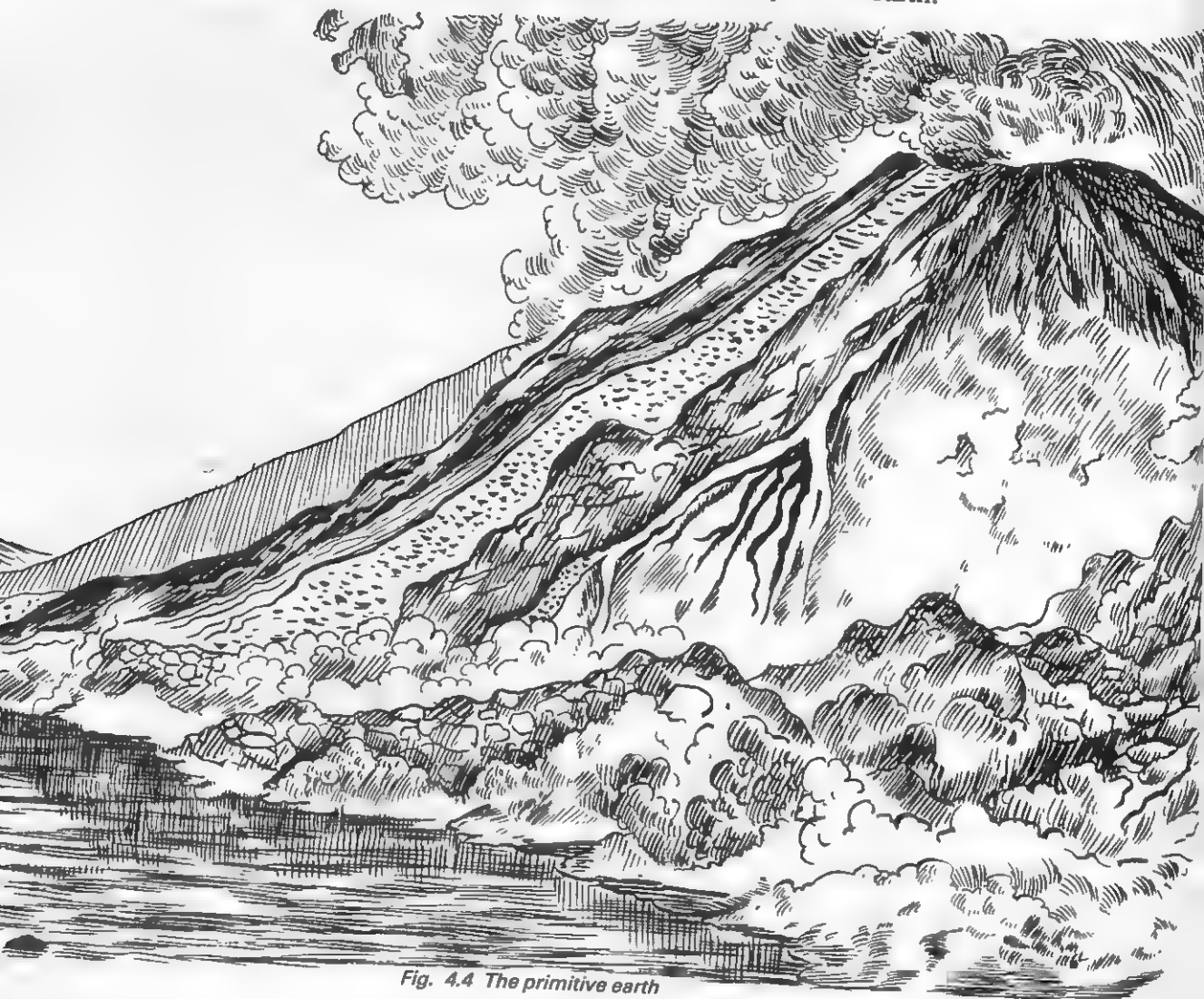


Fig. 4.4 The primitive earth

## CONDITIONS OF PREBIOTIC EARTH

The earth probably started out as a glowing mass of matter which separated from the sun. At first its surface was a terrible place, its rocks were molten, its climate raging with great electric storms. Then slowly, the surface began to cool. Water condensed from steam about 300 million years later to form the first fresh water lakes and salty seas. And it was in water that life first began.

The atmosphere of the early earth contained little or no oxygen, the gas which is important for almost all forms to respire. All the earth's oxygen was combined with other chemical elements in rocks and water. The early atmosphere of the earth, probably, consisted of water vapour, together with gases like ammonia, hydrogen, methane and a little hydrogen sulphide. In this poisonous atmosphere the electrical storms continued to rage. At the same time the earth continued to cool down and this helped in the formation of the earth's crust. Much later the temperature became low enough to start the process of life-producing chemical reactions.

## NON-LIVING TO LIVING ELEMENTS

According to the present concept, life on earth could not have originated over a short span of time as the special creation theory and the cosmozoic theory would have us believe but must have originated over a span of millions of years. The first life must have originated about 2 billion years ago from *non-living matter*. Experiments done by scientists like Oparin, Stanley Miller, etc., have helped us to understand how this might have happened.

## COMPOUND FORMATION OF SUBSTANCES

According to scientists the poisonous atmosphere (of methane ammonia, hydrogen, water vapour, etc.) may have combined under the influence of lightning that raged then and heat and ultra-violet radiation resulting in the formation of complex compounds such as amino acids. These, as mentioned earlier, are building blocks of life. They would have dissolved in the water of ancient ponds, rivers and seas. They would have reacted together chemically to form giant molecules of life which included proteins and nucleic acids. These

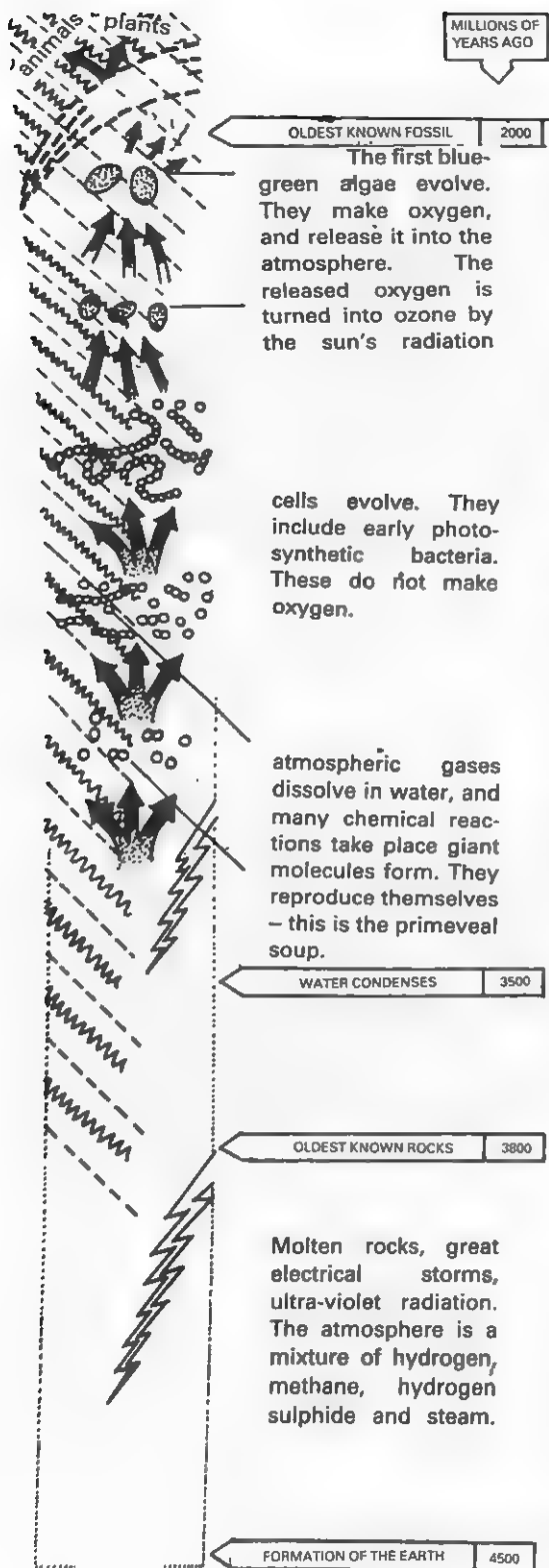


Fig. 4.5 How life began

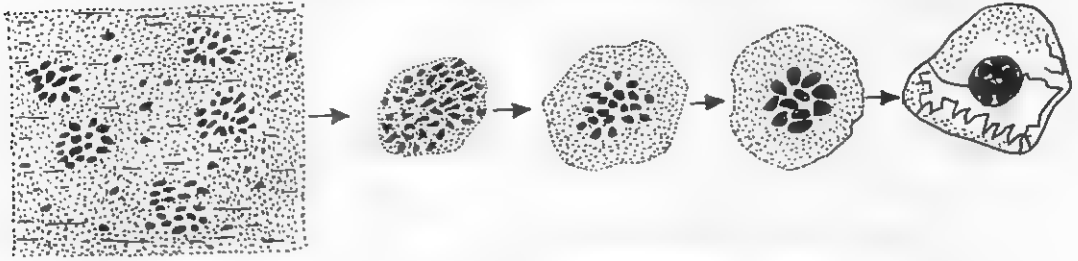
chemical reactions would have happened most often in the pools that were drying up – i.e., where the mixture of chemicals would be the thickest.

For many millions of years, giant molecules of life would have multiplied and broken down again. This must have happened at many places on the earth's surface, until at one unknown place, some combination of giant molecules would have been able to reproduce itself over and over again, as long as its 'food' lasted.

### CELL FORMATION

It is today, believed that a number of complex organic and inorganic compounds in the hot sea water grouped together in various combinations. These settled at the bottom as large masses. Fluid sediments from these formed small globules. Inside these internal reactions took place that led to the formation of what is known as the *pre-cell*. Later on this changed into the first living cell. This cell slowly began to develop into the first living beings. Gradually, through million of years a great number of aquatic organisms began to exist. When the amount of water available for all these creatures to live became less, some of these organisms must have adapted themselves to live on land and thus more and more complex organisms were formed. This is the basis of organic evolution.

**Activity 2 : “Life began many times.” Do you think this is true? How do you think this could have happened?**



*Fig. 4.6 Formation of an early cell*

#### **4.3. More complex forms of life – organic evolution**

A great deal of evidence has been put forward to support the theory that present day complex forms have arisen from originally simpler forms through gradual and continuous changes. This process is termed *organic evolution* which means a gradual unfolding of a continuous process of change over long periods of time.

You have studied in Chapter 1 that the vast variety of animals on our earth vary a great deal from each other – from the simplest unicellular protozoans to the more complex forms. Obviously over a long space of time, one form may have given rise to another form. A particular species may develop certain special characteristics to adapt itself to changing or unfavourable conditions. This special feature is called a *variation*. This variation may be passed on to the next generation and this leads to the formation of a slightly different species than the old species of animal - they have *evolved* from the old ones. These changes take place through a number of generations. The process of evolving a new species is what organic evolution is all about. The animals which can adapt to new conditions evolve and become new species and the ones that cannot change become extinct.

The earliest living organisms were '*heterotrophs*' and had an anaerobic mode of respiration. They got their energy by fermenting organic substances obtained from the sea water. As chlorophyll molecules were formed, some of the heterotrophs became transformed into '*autotrophs*'. These autotrophs were able to manufacture their food from carbon-dioxide and water in the presence of sunlight and oxygen

was evolved during that process. More and more oxygen was liberated into the sea as well as into the atmosphere. Free oxygen led to the formation of many organisms having an aerobic mode of respiration. Thus a new variety of forms came into existence:

#### **4.4. Extinct forms of life – remains of the past life**

Fossil evidence shows us that some species of animals die out and become extinct. Indeed, even today several animals, for instance, the Bengal tiger, are in danger of becoming extinct. This may happen because of a sudden calamity like an earthquake, changing environmental conditions, famine, or because that particular species is hunted and attacked by another species such as man. The fossils of some of these extinct animals have been found and these have provided important links to support the theory of evolution.

Scientists have made a detailed study of an infinite number of plants and animals and came up with overwhelming evidence in support of Darwin's theory of organic evolution.

We now believe that about 500 million years ago when the first life began, all living creatures were aquatic, i.e., they lived in water. There were no land plants or animals. Most of the invertebrate groups that we now know existed in the sea. Then, as some of the waters dried up the first spore bearing land plants appeared. These later began to bear leaves and fruit giving rise to the first coniferous forests providing food and shelter for animals.

The water forms began to change to the first land forms and clumsy amphibians crowded about on the land. Their gills soon changed to lungs and their fins to limbs. At the same time, insects began to develop and multiply.

In the next stage, some amphibians began to lay eggs on land and the first reptiles came into existence. At one period the reptiles ruled the land. Most of them lived on land, a few in water and some others learned to fly. At this time, when reptiles were dominant, the first flowering plants appeared and with them the first butterflies and bees.

In the next age the first small mammal-like creatures appeared and at the same time the first ancestors of the modern bird began to thrive.

About 75 million years ago, some mysterious happenings caused most of the reptile groups to die leaving the earth to the mammals and

birds. It was at this time that most mammals and birds of today appeared, together with the modern flowering plant.

The most recent event in evolution, the appearance of man, must have taken place only about two million years ago when the first human types developed from ape-like ancestors.

**Activity 3 :** Prepare a 'tree of evolution' using dry-twigs, plastic animals, paper, etc.

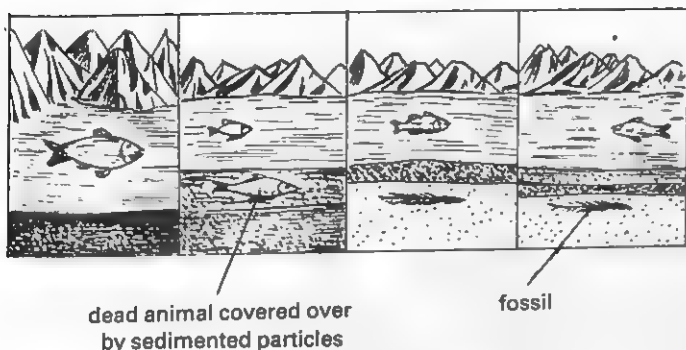


Fig. 4.7 Formation of fossils in sedimentary rocks

*Fossils* are found mainly in sedimentary rocks. Usually when plants and animals die, bacteria and fungi rapidly decompose their bodies. However, under certain circumstances, the harder parts of the bodies of dead plants and animals (e.g. the woody tissues of plants, the bones and the teeth of vertebrates, the shells of molluscs etc.) do not decay but

become buried under layers of germ-free mud which later hardens to form rocks. The remains of plants and animals which are preserved within the rocks in this manner are known as *fossils*.

Paleontologists have unearthed a number of these fossils which have contributed greatly to our present knowledge of evolution.

Because of fossilisation we can see and study the living forms that existed at various times in the history of the earth. A variety of fossils are available today. Under special circumstances, the entire body of an organism may be preserved after death. For instance insects, trapped in the sticky pitch of conifers growing along the Baltic coast over 30 million years ago, can now be studied. Another example of a fossil is the frozen woolly mammoths found buried in ice in Siberia.

Another common process of fossil formation is by *petrification*. This is a copy in stone of some plant or animal part. Fossil wood of this type show preserved *annual rings*. In fossil bones, silicates and other minerals present in the water associated with the sand or mud, have entered porous materials such as the bone marrow or spaces left by the decay of softer parts.

## SIGNIFICANCE OF FOSSILS

If rock bearing fossils whose date of origin are approximately known, are exposed, scientists can gain some knowledge of the plants and animals that existed in those times. The grand canyon is one such example where the Colorado river has exposed a series of rock layers a mile deep representing a two-billion year period of time.

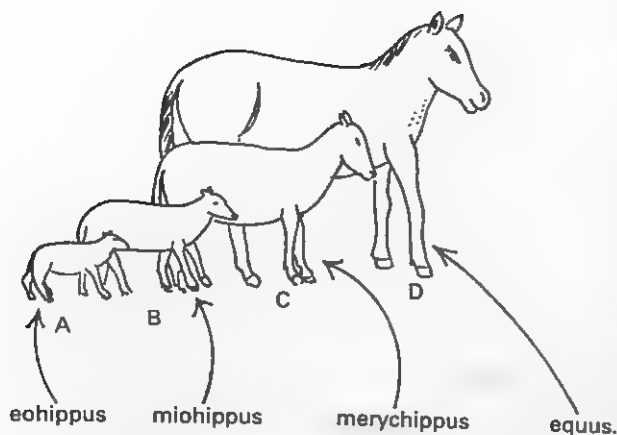


Fig. 4.8 Evolutionary history of a horse.

Another way in which the fossil record can be utilised is to trace the development of a specific family of plants or animals through several million years. The excellent fossils produced by vertebrate animals make this group a good subject for such study, and perhaps the most well-known group here is the horse family.

The present day horse (*Equus*) existed about 60 million years ago. At that time, the animal was the size of fox or cat. It is today called *Eohippus*. It possessed four anterior and three posterior toes. About 40 million years back, the *Eohippus* changed to another form which we now call *Miohippus*. *Miohippus* had only three functional toes on all the limbs. Its size was equal to the modern goat. After about 10 million years *Miohippus* changed into *Merychippus*. The animal resembled a modern ass and the modern horse as we know it arose from this animal only about 200 thousand years ago.

Similarly fossil histories of elephant, camel and man are also known. The fossil histories reveal that evolution has definitely taken place over the years.

**Activity 4 :** Visit a museum and observe fossils. Write a short essay on fossilisation and how records of fossils give us the best direct evidence for the theory of evolution.

**Activity 5 :** Find out about the other, earlier man-like creatures discovered by man. Write a note on each.

## THE EXTINCT FORMS

Extinct connecting links are known as *missing links*. Some of these have been found to occur in the fossil forms of seed ferns and teeth bearing birds. Seed ferns connect the pteridophytes with gymnosperms. The teeth bearing bird *Archaeopteryx* shows us how some of the reptiles possibly got transformed into birds. The *Archaeopteryx* had wings and feathers. It could fly like a bird but it also possessed several reptilian characters like a long tail, teeth, claws on free fingers, etc.



Fig. 4.9 *Archaeopteryx* – an extinct teeth-bearing bird



Fig. 4.10 *Therapsid*

Another form that used to rule the earth and are now extinct are the giant reptiles – the dinosaurs. Among all the dinosaurs and their relatives only a scattered few remain and the dinosaurs themselves vanished long ago. The actual cause of their extinction was not known. One expert thinks that the great changes happening in the earth's crust then may have destroyed the dinosaurs, perhaps, the rising of the Rocky mountains killed them. Even before the dinosaurs evolved there appeared a type of reptile known as *therapsid*. It looked like a mixture of a dog and a lizard. Giant mammals, too, have a tendency to become extinct (e.g., *Deinotherium*). For instance the African elephant is on the verge of extinction.

Thus the presence and distribution of fossils provide us with some of the most direct evidence of the theory of evolution.

**Activity 6 :** The name *Pithecanthropus erectus* meaning upright apeman was given to the first fossil man found. He is now called *Homo sapiens*. Find out why ? Collect information about the descent of man.

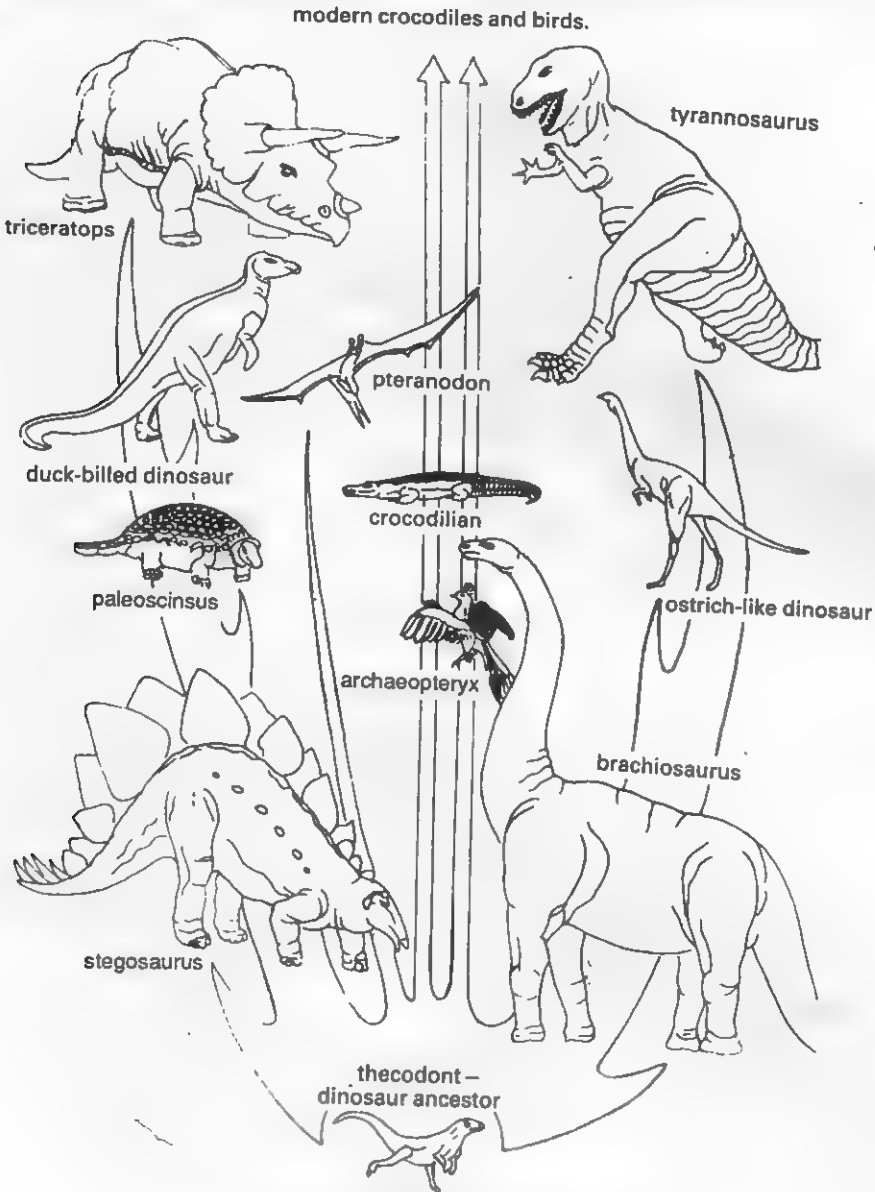


Fig. 4.11 A family tree of dinosaurs and their living relations.

### Some basic concepts

1. The basic plan of development is inherited from the parents.
2. Variation is the tendency of offspring to differ from their parents and this phenomenon is linked with heredity
3. The phenomena of heredity and variation go hand in hand.
4. The process of change is a universal phenomenon.
5. The term organic evolution means a gradual unfolding of a species over long periods of time by which complex organisms are derived from relatively simple forms.

### Some suggested projects / activities.

1. *Write a short skit on Redi's and Darwin's experiments, or prepare a mock interview on T.V. with these scientists to expose their findings.*
2. *Prepare a poster to show how Van Helmont believed that artificial mice could be produced from human sweat and wheat grain present on a dirty shirt.*
3. *Select ten students in your class or school. Find out their genealogy. Tell your class about your findings.*
4. *Who is the Father of biogenesis? Find out more about him and his theory.*
5. *Collect more information about oldest fossils, methods of fossilisation.*
6. *Domestic dogs have increased because they are partners of man. Whereas wolves and jackals are fewer because they compete with man for food and territory. Do you agree with this statement. Give your own suggestions.*

## REVISION TIME

### I. Answer the following questions :

1. What is meant by the term heredity?
2. What is variation?

3. Define 'organic evolution'.
4. What is Paleontology?
5. How old is our planet Earth?
6. When did the first living organisms come into being?
7. What is our current concept of the origin of life?
8. a. What do you know about the fossil, Archaeopteryx?  
b. Explain the cosmozoic theory, the theory of abiogenesis and biogenesis.
9. How did the first living cell come into existence?
10. What is the significance of fossils in the process of evolution?
11. Are fossils being formed at the present time? Give reasons for your answer.
12. What efforts are necessary to ensure the survival of man?

**II. Write whether the following statements are true or false?**

1. Autotrophs are more primitive than heterotrophs.
2. Organic evolution took place before inorganic evolution.
3. Animals had to change when they left the water and began to live on land.

**III. Fill in the blanks.**

1. \_\_\_\_\_ is the tendency of organism to resemble their parents.
2. The earth originated about \_\_\_\_\_ years ago.
3. The formation of \_\_\_\_\_ molecule permitted heterotrophs to change into \_\_\_\_\_.
4. Large amounts of \_\_\_\_\_ were liberated into the atmosphere as the number of \_\_\_\_\_ increased.
5. The theory of \_\_\_\_\_ considers that God's creation is eternal.
6. \_\_\_\_\_ produced artificial mice from human sweat present on a dirty shirt and wheat grain.
7. \_\_\_\_\_ demonstrated that petrification of meat could be prevented by heating and sealing, in air-tight containers.
8. \_\_\_\_\_ gave a definite proof of life arising from pre-existing life only.

## 5. Organisms and environment

*Population and food - factors contributing to the increase of human population - reproductive rate - overproduction - increase in birthrate - lack of natural control - effects of over population - wildlife and conservation in Tamil Nadu and India - factors affecting wildlife - methods of preserving wildlife - wildlife day in India - the oath.*

### 5.0 Organisms and environment

Living organisms depend upon one another and also on their surroundings. In your school garden, you find trees such as neem, mango, tamarind, gulmohar, shrubs such as oleander, bougainvillea, herbs such as marigold and grasses and various animals such as chameleons, garden lizards, squirrels, birds, insects, etc.

A group of organisms in the same area is capable of interbreeding and gives rise to a new generation of the same species. These constitute a population. The word population is derived from 'populus' which means people. A statistical study of the entire human population is known as *demography*.

### 5.1 Population and food

The connection between population and food, is one of the greatest concerns of scientists today. The two most pressing and urgent problems for the world's billions of inhabitants today is 1. to get enough to eat. 2. to control the ever increasing population. The present population growth rates indicates that the world's population in

the year 2,000, will be double what it is today. The population growth is very rapid in Asia, Africa and Latin America where the problem of hunger is acute. The question that is worrying everyone is : Will there be sufficient food to feed the world by the year 2000?

**Activity 1 :** Prepare a histogram chart (a graph) of population growth of different states of India and their annual production of special crops like paddy, wheat etc.

#### FACTORS CONTRIBUTING TO THE INCREASE OF HUMAN POPULATION

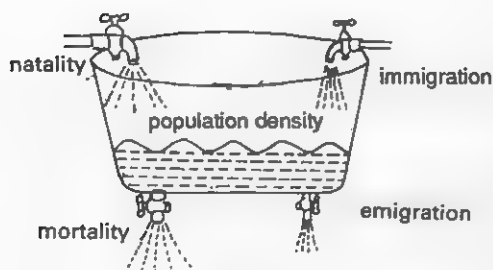


Fig. 5.1 Human population

The human population has been increasing at an alarming rate over the last century or so. The main factors responsible for this is an increased rate of birth (*natality*) and a reduced rate of death (*mortality*). This is because man has increased his scientific and technical knowledge and is able to produce more and better food, control and cure diseases, check floods and prevent droughts.

In developed countries like North America and Europe, both birth and death rates are below the world average, but in the developing regions of Africa, Asia and Latin America birth rates remain higher than death rates. In these regions the standard of living is also poor. Addition of new individuals to the population from other localities is known as *immigration*. Large scale immigration of people from village to cities in search of jobs, food, better living conditions, etc. is another reason contributing to increase in population particularly in the urban industrial areas.

## 5.2 Reproductive rate, overproduction

**Activity 2 :** Find out the number of brothers and sisters your classmates have and try to arrive at a rough estimate of the population of your town or city.

If you determine the number of brothers and sisters you and your classmates have, you will arrive at an estimate that an average couple in India has about four children. Suppose we start with 30 newly married couples, then after 15 - 20 years they, with their children will number

150. We can see how the population can multiply itself within a short period.

The high rate of reproduction in certain countries is due to a higher rate of *fertility* (the ability to have children). If this is true we should enquire into the causes and find suitable methods to control fertility. Possibly, early marriages in certain countries or communities may also have some relation to this problem.

#### OVERPRODUCTION (POPULATION GROWTH)

Although man has used his intelligence to develop himself and make maximum use of the resources present in the world, his domination over other creatures has upset the delicate balance of nature. Early man was able to fit in perfectly with his surroundings, like any other predator. Man, now, is in total control of his environment. This has led to an overproduction of the human race, i.e., many more healthy babies are being born today and less people are dying early. Obviously more healthy individuals are capable of producing more babies and the cycle continues. The size of the population in relation to unit area is called *population density* and this is increasing rapidly due to overproduction.

### 5.3 Increase in birthrate against deathrate

Birthrate (natality rate) is the number of offspring produced per unit time per unit of population. It includes the production of new individuals by birth, germination, division, hatching, etc.

Death rate (mortality rate) is the rate at which the individuals are eliminated from a population by death.

The increase in growth of population is due to better living conditions, sanitation, health schemes, balanced diet, decrease in child mortality, improved agriculture and general improvement in the health of people. This means that on one hand more and more people are reaching the reproductive age, while on the other hand life expectancy has increased.

### 5.4 Lack of natural control

The effect of the world's population has influenced almost all aspects of life. It is absolutely essential for everybody to realise the dangerous

consequences of this and to do everything possible to reduce the rate of growth.

In developing countries like ours, lack of education and superstitious beliefs make it difficult to convince people to have less children. Lack of control is the chief cause of the population explosion.

The rate of population growth has started declining in the developed countries due to the use of better birth control measures, better family planning facilities, increase in educational standards, presence of various kinds of recreation and the shunning of traditional beliefs.

## **5.5 Effect of overpopulation**

An increase in population means large families with more children—as the members of the family increase, the sharing of the income of the family also increases. As a result, parents have to spend more to provide for the basic necessities of life. Naturally, where more children are born to a poor couple, they are physically and mentally less developed because of malnutrition. They will be less capable of doing work efficiently.

Moreover to provide food, shelter and houses, forest land is cleared. Felling down of trees has led to deforestation, soil erosion and loss of soil fertility. This, in turn, has driven out the animals living there and disrupted the balance of nature. Reduction of land available for agriculture has resulted in less food being produced. Also, over concentration of the population in some areas and increase in the number of factories has led to air pollution.

Thus, we realise that because of overpopulation, the supply of food, fuel-power, transport, health care and many other needs cannot keep pace with the increase in numbers.

## **5.6 Scarcity of space and food**

Space and food are the basic necessities of life. In large families, adequate food, hygienic dwelling places, medical facilities, education, suitable clothing, ways of recreation, etc. are not possible because these require a lot of expenditure.

## MAIN CAUSES WHICH PREVENTS THE CONTROL OF POPULATION

The main causes that prevent the control of population are 1. lack of education, 2. traditional beliefs (children are the gifts of God) 3. desire for a son, 4. economic reasons (some consider children as helping hands to earn their livelihood), 5. mortality rate (due to high death rate among children, parents feel it safe to produce more children).

*Activity 3 : Find out the growth of population in India before and after independence.*

*Activity 4 : Collect newspaper cuttings on 'family planning'.*

### 5.7 Wildlife and conservation

The term wildlife covers any or all non-cultivated and non-domesticated life in its natural surroundings. The native populations of a community make up its wildlife.

Forests occupy about one third of the world's land surface. They are ecosystems that are dominated by trees. Like the forest, wildlife is another valuable asset of nature. It has links in food chains from which we benefit. For example, birds of prey and snakes control the rodent population which damage crops. Thus wildlife also performs the role of biological control. It also helps to maintain recycling of matter which makes the soil fertile. Trees and vegetation produce life-giving oxygen and protect the soil from erosion by wind and water. When we destroy forests, harmful insects increase in number, since there are no birds to eat them. The ecological equilibrium is disturbed by clearing grasslands, building dams, drains, excavation of mountains and other activities.

#### CONSERVATION

Man is a child of nature. His life depends upon the availability of resources in nature. Man depends upon soil, animals, coal, oil and minerals for the basic necessities of life. There are two kinds of resources : *renewable* resources (soil, water, forest and wildlife), and *non-renewable resources* (minerals, oil and coal).

Man faces two problems. He has to ensure the availability of resources for the growing population and also has to preserve the natural environment in a state suitable for life.

## 5.8 Wildlife in Tamil Nadu and India

There are many wildlife sanctuaries and parks in Tamil Nadu which help to conserve wildlife. Some of the sanctuaries are :

### 1. THE MUDUMALAI SANCTUARY

It is situated in Nilgiris districts. Here Indian elephants are found in herds. Bonnet monkeys and four-horned deer are common animals found in this forest.

### 2. THE VEDANTHANGAL BIRD SANCTUARY

It is situated in Chingleput district. Thousand of birds of different species migrate from all over the world to the Vedanthangal lake. Pelican, painted stork, grey-heron and egret are some of the common birds seen here.

### 3. THE VEDARANYAM SANCTUARY (Kodikarai sanctuary)

It is situated in Tanjore district and is famous for its birds.

## WILDLIFE IN INDIA

There are more than 500 different species of mammals found within the Indian region.

The Indian Lion (*Panthera leo*) is only found in the Gir forest in Gujarat which is an ideal habitat for the lion.

The tiger (*Panthera tigris*) may be Lord of the jungle, but it is equally at home in swamps or the cold Siberian forest. The Indian tiger is a rich-coloured, well-striped animal with a short coat. It is found practically throughout India, from the Himalayas to Cape Comorin.

The *Cheetah* or hunting leopard once common in Central India, is now almost extinct in the wild state.

The *bear* has thick hair, an elongated snout, bad eye sight and powerful claws. It feeds on sheep and vegetables.

The *elephant* is the largest living land animal and is very intelligent. It lives upto 70 years. Elephants are very adaptable for living in a wide variety of habitats, i.e., forests, grasslands, river valleys and desert scrub. In India, elephants are distributed over the Western Ghats, from

Mysore southwards, Orissa, Bihar, Himalayas in U.P., West Bengal and Assam. There are only two types, of elephants, the Indian elephant (*Elaphas maximum*) and the African elephant (*Loxodonta africans*).



Fig. 5.2 Rhinoceros

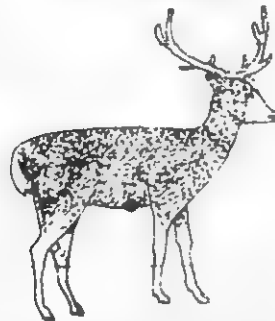


Fig. 5.3 Spotted deer

The great Indian rhinoceros (*Rhinoceros unicornis*) is found in the Kaziranga sanctuary in Assam and Jaldapara in West Bengal. It is large, nocturnal and herbivorous. It feeds on tender grass shoots. Its skin is hairless, folded and tough and looks like an armour. This was used in olden days for making warriors' shields. The Indian rhinoceros bears one horn over its snout. The African and other rhinos have two such horns.

Rhinos have been shot for their horns and sold in the far East where it is believed that

they can cure all sorts of diseases.

Deer are gregarious. The male (*stag*) has antlers which can also occur in the female (*hind*). The *swamp deer* is the largest known deer and the *spotted deer* has white spots and a dark streak on the back. *Hog deer* and *Sambar* are two other types which occur in India. *Musk deer* is without horns

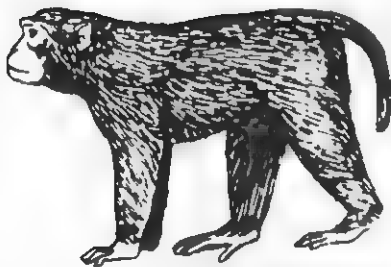


Fig. 5.4 Rhesus monkey

The Arabian camel with one hump lives in India. The Turkish camel is smaller and has two humps.

Monkeys are of numerous types. The common Indian monkey (*Rhesus monkey*) has a rounded red face. The Rhesus monkey is both terrestrial and arboreal.

## 5.9 Factors affecting wildlife

Large scale *deforestation* takes place due to rapidly increasing human and livestock population. Forests are destroyed for fuel (firewood, charcoal), timber, fodder, industrial raw materials (paper, rubber, etc.)

and other forest products (gum, resin, medicinal plants, spices, oils, etc.). Trees are cut and vast areas made barren for mining of certain ores. Due to this, water pollution, fire hazards and air pollution increases. Natural forces such as earthquakes, floods and landslides contribute to the destruction of forests.

One of the major environmental disruptions caused by human beings is the extensive killing of animals, even rare species, to satisfy their needs of *food, dress and sport*. Drainage of marshes affects water birds. Many birds are slaughtered for their feathers and flesh. Some species of cranes, partridges, doves and hornbills are at the point of extinction.

For centuries a large number of wildlife species have become extinct or have been facing extinction.

Since the year 1600, about three hundred and sixty known species of animals have become extinct. The rate of extinction is alarming. The lion, tiger, leopard, cheetah, rhinoceros, Indian wild ass, Kashmir stag and musk deer are some of the animals facing extinction. Some birds like the pink-headed duck and the white-winged wood duck are also becoming rare. The Indian wild ass, the Kashmir stag, the swamp deer are some of the highly exploited animals. About eleven species of flying squirrels have become very scarce. The leather back turtle, the green sea turtle, etc. are particularly threatened in India due to their demand for trade in flesh and shell. Living snakes are captured for their venom and are wanted by zoos and snake charmers.

**Activity 5 :** Visit a local zoo. Find out more about animals in that zoo.

**Activity 6 :** Encourage animals to visit your garden. Attract birds and bats by putting up special boxes for them. Watch butterflies and moths when they visit flowers.

### SAVE THE FORESTS

The soil in the forest is not very fertile. It needs the richness from decayed leaves falling from the trees. When trees are felled, there are



Fig. 5.5 All these goods involve the death of rare animals



Fig. 5.6 Badges of some wildlife clubs

no more leaves to fall and the soil loses its fertility. Without trees to shield it from the rain storms, the weak soil is washed away easily. Many tonnes of valuable soil are lost each year this way.

Forests play a very important role in helping to maintain the level of rainfall necessary for existence. They recycle moisture back into their immediate atmosphere by transpiration so that it again falls as rain. The clearing of forests reduces the amount of rainfall.

Rubber, bananas, cocoa, spices, tea, coffee, timber, paper, fibre, ornamental plants are a few of the many things we get from the forest.

The following measures should be adopted to conserve forests. 1. Trees should not be felled without the prior permission of the government. If felling of the trees becomes essential, for every tree cut, two trees should be planted in a planned manner. 2. Vana Mahotsava should be observed every year by everybody. 3. Researches in social forestry, agro-forestry, forest technology and allied fields should be encouraged. 4. People should be educated about reclamation of waste lands, forest industry, etc. 5. Nurseries should be established for forest trees. 6. Forests should be protected from fires and grazing animals. 7. Forest land should not be used for agricultural purposes. 8. Cutting and uprooting rare plants should be classified as a severely punishable crime.

## 5.10 Methods of preserving our wildlife

Today every country has laws to protect and conserve its natural resources. Wildlife sanctuaries and national parks help to conserve wildlife. The year 1972 was declared as conservation of nature and natural resources year.

The Indian Board of Wildlife (established 1952), for instance, has specialized zoos, flora and bird wings. The central Government in India controls, preserves and

even acquires certain forests of national importance.

A large number of international organisations are dedicated to the cause of wildlife conservation. Everybody must understand the importance of this problem and lend their support whole-heartedly.

The function of the Indian Board of Wildlife includes the devising of way and means of conservation and control of wildlife through practical measures, the sponsoring and setting up of national parks, sanctuaries and zoological gardens, and the promotion of public interest in wildlife.

#### WILDLIFE WEEK IN INDIA

To educate the public on the importance of wildlife, the government celebrates the 'wildlife week' during the first week of October every year. During this week, the government organises film shows, debates, essays, painting and oratorical competitions on wildlife for school and college students. The government encourages the public to pledge to protect our wildlife and forest wealth. Visits to zoological parks and wildlife sanctuaries are offered at concessional rates.

*Activity 7 : What do you eat? What clothes do you wear? Find out what plants and animals were involved in providing these.*

*Activity 8 : Find out more about the wildlife organisations in India and the world. As a student, how can you help them?*

#### Some basic concepts:

1. Human population has been growing at a tremendous rate.
2. The size of population in relation to per unit area at a given time is called its population density.
3. Lack of education, traditional beliefs, desire for a son, economic reasons, etc, prevent the control of population in our country.
4. Natural resources are of two types -- renewable and non-renewable.
5. Forests are important for the economy of the country and should be preserved.
6. Wildlife is the term used for all kinds of non-cultivated and non-domesticated living things.
7. Hunting and trading of rare species of animals should be banned.

### **Some suggested projects/activities**

1. *Prepare a poster on any 10 extinct animals.*
2. *Give a micro-lecture on conservation of wildlife.*
3. *Collect the badges of some clubs of wildlife. Display them on your bulletin board.*
4. *Organise film shows, debates, essay writing, painting and oratorical competitions on wildlife.*

### **REVISION TIME**

#### **I. Fill in the blanks:**

1. \_\_\_\_\_ indicates the number of offspring produced unit time per unit population.
2. \_\_\_\_\_ is defined as the statistical study of population.
3. The two types of natural resources are \_\_\_\_\_ and \_\_\_\_\_.
4. \_\_\_\_\_ is an animal produce.
5. Oil is extracted from the seeds of \_\_\_\_\_.
6. \_\_\_\_\_ is a poisonous snake.

#### **II. Match the following:**

- |                         |                      |
|-------------------------|----------------------|
| i. Lion                 | South Arcot district |
| ii. Rhinoceros          | Kaziranga sanctuary  |
| iii. Archaeopteryx      | Nilgiris district    |
| iv. Mudumalai sanctuary | Extinct bird         |

#### **III. Write short notes on**

- a) Forest products
- b) Wildlife conservation
- c) Significance of family planning
- d) Population explosion.

#### **IV. Answer the following questions:**

1. What is meant by population density?
2. Why has the the rate of growth of population started declining in the developed countries?

3. What is the relationship between population growth and    a. poverty and  
b. disease?
4. Why has it not been possible to appreciably check the growth of population in our country so far?
5. How do trees prevent soil erosion?
6. What steps do you propose for conservation of wildlife?
7. What are the reasons for which animals are hunted?
8. Give an account of Indian fauna.
9. Prepare a list of animals that are on the verge of extinction.
10. How does man threaten the survival of animals?

**V. Find out about:**

1. Family planning    2. Indian and African elephants    3. One humped and two humped camels.
4. Poisonous and non-poisonous snakes in India.    5. Local bodies engaged in the preservation of wildlife.

## 6. Economic Zoology

*Economic zoology - useful animals - honey bees - composition and uses of honey - silkworms - poultry - egg and meat - animal husbandry - breeding and feeding - types of cattle, dairy breeds, drought breeds, feeding practices, food habits, shelter, care - sheep - food and shelter, uses - process of removal of wool, quality of wool.*

The study of usefulness of animals is known as *Economic zoology*.

Many insects are useful to us. Some of these are the lac insect, silk worm and the honeybee. They produce certain materials at some stages of their life-cycle which are of great economic importance to man. Because of this, these insects are reared on a large scale.

*Activity 1 : Try to visit an apiary. Find out more about rearing of bees.*

*Activity 2 : Prepare a model of a hive with plastic clay and write a note on the construction of a bee-hive.*

*Activity 3 : Visit a sericulture farm. Find out about the rearing of silkworms at home. Get all the materials necessary and try to do it as a hobby.*

### 6.1 Useful animals

#### HONEYBEES

There are many kinds of bees. The most familiar being bumble bees and honeybees which live in bee-hives, in colonies where they have a rigid caste system. A single *queen* reigns over the hive only because she lays the eggs. There are many *drones* which are all males. Their only

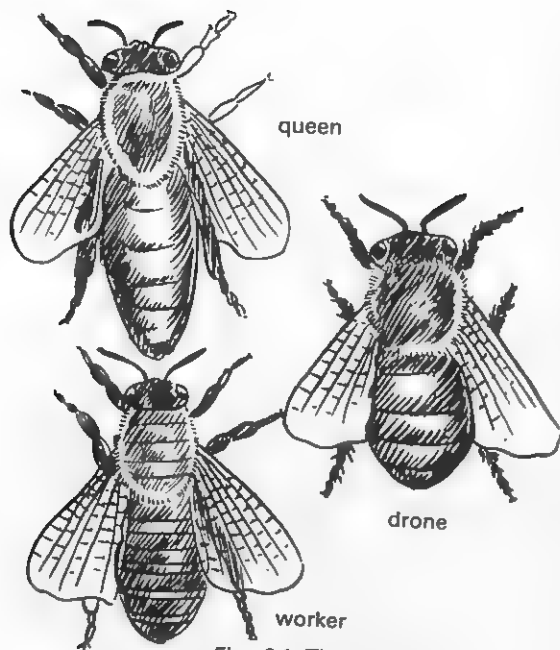


Fig. 6.1 Three types of bees

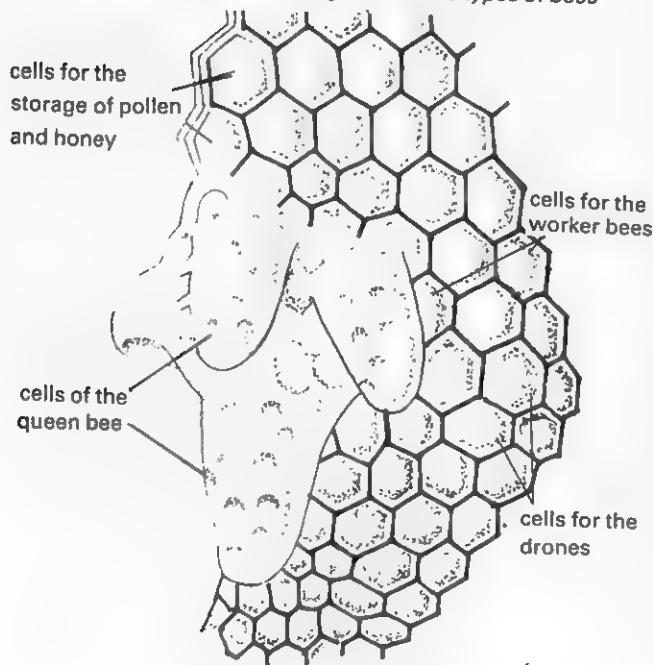


Fig. 6.2 Structure of a bee-hive

function is to mate with the young queen. The sterile or non-egg laying females are called the *workers*.

**Composition of honey :** Fresh honey contains 17% water and 78% sugar besides many enzymes and mineral salts. Only bees can prepare honey. It is not possible to manufacture it synthetically.

**Uses of honey :** Honey has important medicinal value and is used as a cure for various diseases. For this reason, certain kinds of bees are encouraged to nest in artificial hives so that their honey may be collected easily. Honey has a decided advantage over other foods in that it never goes bad, as germs do not thrive in honey. It improves the condition of blood and is very effective in the treatment of a cold. Honey is an essential ingredient in many ayurvedic medicines. The custom of applying honey over burns has been in practice for many centuries in our country. It is a good preservative. Jack fruit, mango, etc. can be preserved in honey.

## SILKWORM

The silk we wear comes from the cocoon stage of the silk-moth. The practice of rearing silkworms is called *sericulture*.

**Activity 4 :** Find out the leading silk-producing countries of the world. Do they follow any novel methods to get the produce (yield) quickly?

There are many kinds of silkworms such as *Bombyx mori*, *Eri silkworm*, *Muga silkworm* and *Tassar silkworm*. The *Bombyx mori* breeds on mulberry plants and the best silk is produced by these.

**Life history of silkworm :** There are four stages in the life history of silkworm. It is an example of complete metamorphosis.

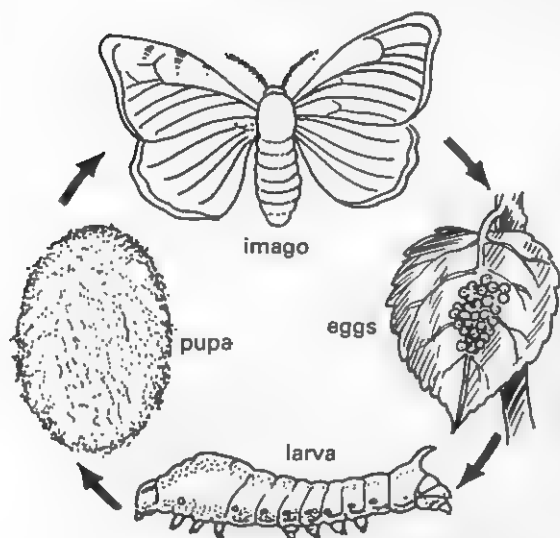


Fig. 6.3 Life cycle of the mulberry silkworm

**Eggs :** The silk - moth lays its eggs on the lower surface of mulberry leaves. The eggs are firmly attached to the leaves by a sticky substance secreted by the moth.

**Caterpillar (larva) :** The silkworm is the larva of a moth. After hatching from the egg, the larva feeds for about a month on the leaves of the mulberry tree. As the size of the larva increases the skin is shed and a new skin is formed. This process is known as *ecdysis*. During the larva stage, nearly four moultings take place.

**Pupa :** When fully grown, the larva stops feeding and chooses a twig of the tree. Soon it secretes a sticky fluid on exposure to air. The larva spins the fibre around its body and forms a cocoon. In about 15 days it attains the pupal stage inside the cocoon.

**Imago (adult) :** If the pupa is allowed to live, it soon emerges out of the cocoon as a moth after metamorphosis. The emerging moth is known as *imago*.

Sericulturists gather the pupa and kill them in boiling water. After killing the pupa inside, they collect the silk fibre from the cocoon and twist them into yarn. A few are kept alive so that moths can develop which are needed for further breeding.

## POULTRY — EGGS AND MEAT

Eggs and meat are nutritious food. They are the best sources of proteins. Eggs contain vitamin A, B<sub>2</sub>, iron, phosphorus and other minerals. Home poultry gives us regular supply of egg and meat.

We do not require a large capital to start a farm. A small open space

at the backyard and a little capital are all that we need.

There are many methods for starting a farm.

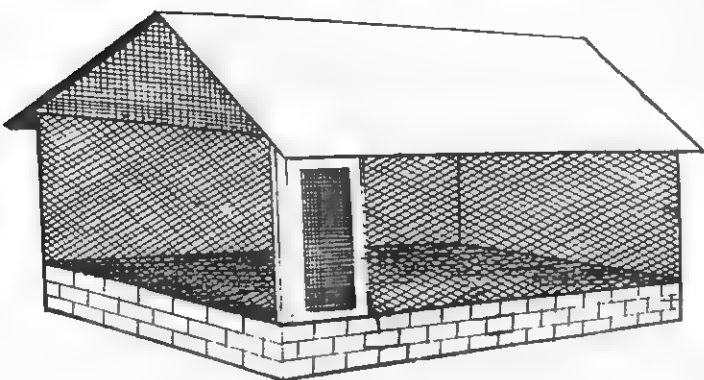


Fig. 6.4 Poultry house

*First method* : Choose an open space in the backyard ( $3\text{m} \times 3\text{m}$ ). Clean the place and construct a parapet wall of about 3 feet, around the space. Construct an enclosure made of wire mesh with a roof. Spread saw-dust or wood shavings or cut straw on the floor, to a depth of 75 cm. This is to protect the birds from the hazards of extreme weather. About 15–20 fowls can be kept in this

enclosure. This method is found to be highly economical.

*Second method* : Fowl are allowed to wander about throughout the day in most villages. At night, they are kept in large baskets. The birds may become an easy prey to their natural enemies.

*Incubation* : In most of the villages, country hens are used for hatching. A country hen can sit on ten eggs at a time. This is the natural method of hatching.

In big poultry farms incubators are used to hatch hundreds of eggs at a time. The incubator maintains an optimum temperature of  $30 - 39^{\circ}\text{C}$ . The egg hatch in about 21 days.

Chicks upto the age of eight weeks are known as *brooders*. The brooders are reared in a brooder house. Food and water are provided in clean troughs. Vitamins and antibiotics are mixed with the feed. The chicks are debeaked after four weeks to prevent them from attacking each other.

The food value of a hen's egg as estimated from the composition of a whole fresh egg per 100 g. is as follows :

protein	= 11.9 g.
fat	= 12.3 g.
carbohydrate	= nil
calcium	= 5.6 mg.
iron	= 3.0 mg.
calorific value (energy)	= 682 kj

## 6.2 Animal husbandry - breeding, feeding

**Activity 5 :** *Prepare a poster showing different dairy breeds. Write suitable captions for your posters.*

In our country, though the number of animals is large, yet our intake of meat, milk and eggs is very little. The work efficiency of the animals is very low.

One of the main causes for this is the absence of improved varieties of animals. Proper animal husbandry can improve the type of animals reared. This can be achieved by hybridization of better varieties and providing a good healthy environment.

## 6.3 Types of cattle — dairy, drought breeds, feeding practices, food habits.

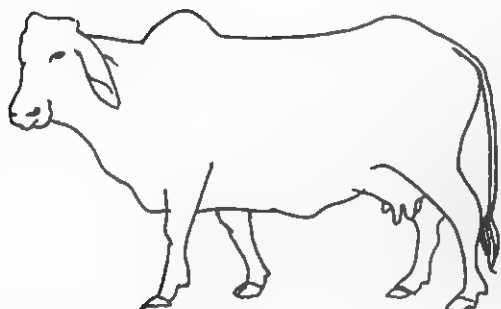


Fig. 6.5 Sahiwal cow

### THE IMPORTANT BREEDS OF CATTLE

Guernsey, Jersey, Holstein, Shorthorn, Friesian, Brown-swiss and Indian Zebu are some of the wellknown breeds of cattle.

Brown-swiss, Guernsey and Jersey are usually used for dairy purposes. Humped Zebu (Indian Zebu), Sahiwal, Sindhi, Gir, Deoni Tharparkar and Kankrej are good Indian milch breeds. Kangayam, Malvi, Siri and Ongole are better drafters.

### BUFFALO

The best known breeds of Indian buffalo are Murrah, Jaffrabadi, Surti, Nili and Bhadawari. Murrah has excellent milk producing capacity. It is found in Delhi, Punjab, Uttar Pradesh and Rajasthan.

## 6.4 Sheep and goat

### GOAT

Goats are known by the name of the place where they are found. They are economically valuable and yield milk, meat, hair and skin.

*Kashmiri, Chamba and Pashmina* are some of the names of goat.

## SHEEP

Sheep in India are more often used for the production of wool. Like goats, their common breeds are named after the place where they are found, namely Gaddi, Lohi, Pashmina, Bhakarwal and Karanah.

## DAIRY PRODUCTS

Milk, cream, butter, ghee, buttermilk, cheese, *khoa* are some of the dairy products.

*Useful products* : Fibre, hide and skin, bone, horn and hoof are some of the other useful products obtained from animals.

*Feeding* : Cattle normally consume 2.0 - 2.5 kg. of dry matter per individual per day for every 100 kg of their live weight.

Buffaloes, being heavy eaters consume 2.5 - 3.0 kg of dry matter for every 100 kg of their live weight. This consists of 70% roughage and 30% concentrates.

Goats usually graze and browse on all types of vegetation, leaves, tender buds, twigs, grasses, weeds, wild plants, peelings of vegetables and fruits, tree prunings, etc.

Normally *sheep* require 1-2 kg of leguminous hay per head per day depending upon their age and body weight.

## 6.5 Process of removal of wool — quality of wool

### SHEARING

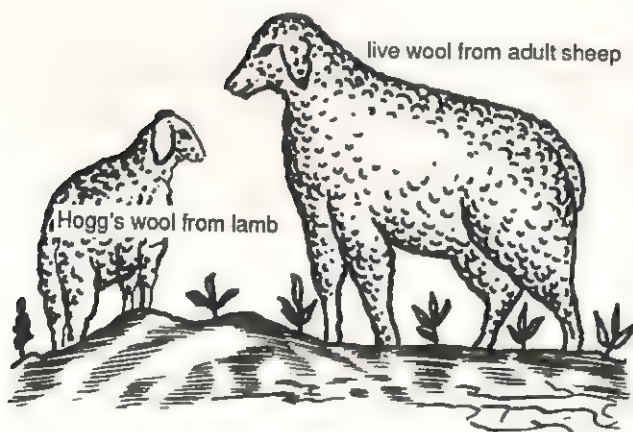


Fig. 6.6 Sheep with wool

*Shearing* or removal of wool is good for the health of the animals and the fibre is useful to man. Shearing is done in mild weather conditions in February, March, August and September, when rich grazing is available in the fields.

*Quality of wool* : Wool is of three types:

1. *Virgin or live wool* obtained from adult sheep by shearing.
2. *Hogg's wool* obtained from lamb.

3. *Pulled wool or tannery wool* available from the skin of dead animals.

The quality of wool is judged from its fineness, diameter of fibre, length, strength, elasticity, colour, lustre, effect of moisture, etc.

#### SHELTER AND CARE OF ANIMALS

Specially designed houses are built to suit the needs of each type of animal depending upon its breed and size. These houses should be clean, well-ventilated and protected from various diseases. There should be separate places for the mothers and their offspring. Animals should be washed and groomed periodically.

For cross breeding or *hybridization*, economically useful animals, healthy (resistant to diseases) and the best animals should be identified and put to use.

*Artificial insemination* is one of the important techniques in which sperm cells of a few highly selected males is introduced into the genital tract of females by the use of appropriate instruments to bring about genetic improvement of an animal.

**Activity 6 :** *Classify the animals of a local zoo, natural park or of your village or town into those which are domesticated and which cannot be domesticated.*

#### Some basic concepts

1. Honeybees and silk-moth are classified as economically useful insects.
2. Animal husbandry deals with the care, feeding, getting better breeds and management of animals.
3. Food and climatic conditions greatly affect the produce of livestock.
4. Selection, hybridization, artificial insemination, etc. help us to get better varieties of animals.

#### Some suggested projects/activities

1. *Visit a poultry farm and find out about the different breeds and their laying capacity.*
2. *Go to the veterinary hospital and prepare a list of vaccines given to different animals.*

3. *Collect the printed materials from various live-stock farms and select the best ones. Display them on your bulletin-board.*

## REVISION TIME

### I. Answer the following questions :

1. What are the different kinds of honeybees in India?
2. What are the different types of silkworms?
3. What is ecdysis?
4. How would you start an economically sound poultry-farm?
5. What are brooders?
6. Why is milk considered a wholesome food?
7. Stray animals that you see on the roads or in the streets are not called wild animals. Why?
8. If you keep a fowl's egg at home for sufficient time at room temperature, it does not hatch into a chick but decays. Why?
9. Even in this electronic age, it is not possible for man to be completely independent of animals. Comment.
10. What is animal husbandry?
11. Name a few better breeds of Indian buffalo.
12. Name a few common breeds of sheep.
13. In spite of the large population of cattle in our country, milk production is meagre. Why? How do you improve milk production?
14. What is artificial insemination?

### II. Write short notes on

1. Animal husbandry, 2. Honeybees, 3. Types of cattle, 4. Dairy and drought breeds, 5. Shearing, 6. Quality of wool, 7. Poultry, 8. Silkworm.

## TEST PAPER — I

Time : 1 1/4 hrs.

### I Answer the following questions :

1. Tabulate the differences between living and non-living things.
2. Enumerate the common features of all living organisms.
3. Write a short note on the significance of classification.
4. Name the different phyla of invertebrata.
5. Classify chordates and give an example for each.
6. Give an account of the diseases caused by protozoans, plasmodium and Entamoeba species.
7. Write an essay on 'transmission of diseases'.
8. Give an account of the life history of a malarial parasite with suitable illustrations.
9. Enumerate the various methods of food preservation.
10. What are the modern methods of storing food?
11. Give an account of the role of any three endocrine glands in the human body.

### II. Write short notes on :

1. The role of muscles, bones and tendons.
2. adrenals.
3. pituitary gland.
4. islets of Langerhans.
5. ingestion.
6. absorption
7. abiogenesis
8. biogenesis
9. organic evolution.
10. wildlife and conservation.
11. animal husbandry.

### III. Differentiate between :

1. Animal husbandry and wildlife sanctuary.
2. natality and mortality.
3. demography and population education.
4. hybridization and artificial insemination.
5. abiogenesis and biogenesis.
6. ingestion and digestion.
7. absorption and egestion.
8. receptors and effectors.
9. voluntary and involuntary action.
10. vectors and pathogens.

## TEST PAPER — II

Time : 1 1/4 hrs.

### I. Answer the following questions :

1. What are the various methods of procuring food?
2. Give an account of the changes that take place to food in our body.
3. Write a note on absorption.
4. Define population and demography
5. Give reasons for :
  - a. Stable and declining population growth in a developed country.
  - b. Population explosion in developing countries.
6. What is organic evolution?
7. Give an account of the extinct forms of life.
8. Write the significance of domestic animals.
9. List the various dairy products.
10. Try to categorise and give three examples of animals generally used for meat, transport and labour.
11. Write the importance of animal fibre, hide and skin, bone, horn and hoof.
12. Name any three poultry birds.

### II. Write notes on :

1. utility of classification. 2. major groups of animals. 3. vectors.
4. controlling harmful microbes. 5. Edward Jenner's experiment. 6. immunity. 7. defensive mechanism. 8. antiseptics. 9. sterilisation. 10. pasteurisation.

### III. Differentiate between :

1. reproduction and heredity. 2. antiseptics and antibiotics. 3. invertebrates and vertebrates. 4. aves and reptiles. 5. drying and boiling food. 6. skeletal and muscular system. 7. drone and worker bee. 8. larva and cocoon of silkworm.



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